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ON SOME CAUSES WHICH INFLUENCE TOPOGRAPHICAL CHANGES AND GEOLOGICAL FORMATIONS IN THE CHANNEL ISLANDS OF CALIFORNIA.

BY DR. LORENZO GORDIN YATES.

During a recent visit to San Miguel, the most westerly of the so-called "Channel Islands," off the coast near Santa Barbara, my attention was attracted to phases of the history of the island, which proved intensely interesting.

The general trend of the coast of California is north-west and south-east, but at Point Conception, about 240 miles southeasterly from San Francisco, the direction changes to east and west, and this bend, with the chain of islands distant about 25 miles, forms the Santa Barbara Channel, running parallel with the Santa Ynez Mountains.

These islands are notable from their having furnished shelter to the ships of their discoverers, the old Spanish navigators commanded by the Portuguese, Cabrillo, who died in about the year 1543, and whose body is supposed to have been buried on San Miguel.

The islands east of San Miguel, are Santa Rosa; Santa Cruz; and the Anacapas.

They are separated from each other by channels of from four to five miles in width; they are of eruptive origin, and their areas are principally occupied by a range of low mountains running parallel with the Santa Ynez Mountains,

and with the coast, forming the longer axis of each of the islands above named.

The prevailing winds of the coast, except in January and December, come from the northwest, and form such a reliable meteorological feature as to be called "The Summer trade Winds." Back of the Coast Ranges of Mountains these winds are scarcely perceptible, except where there is a depression in the highlands upon the coast, where the sea breeze rushes in to fill the partial vacuum caused by the rising of the heated air of the valleys. In these instances the portion of the wind-force deflected from its general direction, follows up the line of the main valley and its tributaries, its force being rapidly diminished as it recedes from the main current.

These deflections are apparent at the Golden Gate; the Pajaro and Salinas rivers; the Santa Ynez and Santa Clara Valleys, and various other points north and south.

At Point Conception the mountains extend to the coast, and if the depression forming the Channel were a heated valley, it would draw a large portion of the current of cold, fog-laden wind to replace its over-heated atmosphere. The cool, temperate, sea-filled Channel offering no such conditions, the wind continues its course, without obstruction, across the mouth of the Channel, a small portion only being deflected in an easterly direction. This follows the Santa Barbara Channel with rapidly decreasing force, and long before it reaches Santa Barbara it is represented by a gentle westerly breeze, of which sailing vessels take advantage in making their runs to and fro, between the mainland and the islands.

The main current of wind continues on its course in the direction of San Miguel and Santa Rosa Islands which it sweeps with unabated force, carrying the dry sand from the windward shores and dispersing it in the form of drifts over the entire surface; and I have been at the west end of Santa Rosa Island when the sand was being blown over from San Miguel like a drifting snow storm, over a distance of fully four miles of intervening waters.

These islands were formerly covered by a dense growth of vegetation, and densely populated by aborigines, but since the

advent of the whites, the aboriginal tribes have become extinct, and the introduction of sheep and cattle, to the pasturage of which they have been entirely devoted for many years, has so far destroyed the vegetation as to render a large proportion of some of the islands barren wastes, and land which formerly supported hundreds or thousands of human beings, is fast becoming occupied by shifting sands of no value whatever.

The principal cause of this desolation is the destruction of the plants by sheep; the thick carpeting of the seashore by Mesembryanthemums and other succulent plants kept the sands confined to the immediate shore line, and trees, shrubs, herbaceous plants and creepers served to protect the soil from the destructive agency of the wind and rain; whereas, large areas of the surface now show no evidence of its former condition other than the presence of countless thousands of the dead shells of a snail peculiar to these islands (*Helix ayresiana* Newc.), the bleaching bones of the aborigines, and the vast accumulations of the refuse of their camps, together with the casts of dead trees and shrubs, whose places in the soil appear to have been filled by concretionary columns of sandstone which stand erect, sometimes projecting from two to four feet above the present surface, like gravestones in a cemetery, showing how the soil in which they grew has been blown away. These again will be covered by sand dunes, which may eventually become solid rock and puzzle geologists of future ages.

These casts appear to have been formed by sand falling into the cavities in the soil, the latter having become hardened by exposure to the action of wind and sun, when deprived of the protection of the growth of vegetation; the dead roots of the shrubs decayed, leaving their impress in the mold; these molds filled with sand during the dry season, would, during the rainy season, hold the water which, filling the interstices, furnished the mineral substance which cemented the grains of sand into a solid mass.

On the northeasterly shore of San Miguel Island is a crescent-shaped harbor, protected from the northwest winds by a ridge of basaltic rock, called Harris Point, which forms the

northern extremity of the island; over this point the wind sweeps with great force, carrying the sand mixed with fragments of shells, *Helix ayresiana*, marine shells and other debris from the rancherias, &c.

The sand beach forming around Cuylers Harbor, above referred to, is composed of sand with a large proportion of fragments of the land shell, and a small proportion of those of marine origin.

Santa Barbara, California,
August 16*th*, 1891.

ON PROBLEMATIC ORGANISMS, AND THE PRESERVATION OF ALGÆ AS FOSSILS.

BY JOSEPH F. JAMES, M. SC., F. G. S. A.

For many years past the subject of the animal or vegetable nature of a large class of fossil bodies has been a matter of discussion between two schools of geologists. One of these considers as fucoids or algæ a certain group of forms whose members do not present any organic appearance, but which in the early days of their study were made to do duty as plants, and which consequently still pose as such. The other class refuses to recognize the fossils as the remains of plants, and point out the analogy they present to worm trails, worm borings, animal tracks or marks of inorganic origin. These schools are represented on the fucoid-side by Saporta, Delgado and others, and on the opposite side by Nathorst, Dawson and others.

The attention of the present writer was first attracted to these fossil forms by their abundance in rocks of Lower Silurian age in the vicinity of Cincinnati, Ohio, the geologists there universally regarding them as plants. During the summer of 1884, while engaged in arranging the collections of the Cincinnati Society of Natural History many specimens were studied; and as supplementary thereto the markings made by various insect larvæ, shells, or by running water upon the mud-flats of the Little Miami river. The result of these studies was a paper on the "Fucoids of the Cincinnati Group," published in the Journal of the Cincinnati Society of Natural History, in October 1884 and January 1885. In this paper some of these so-called fucoids were referred to inorganic causes; many more to trails and burrows, and some few to graptolites. None were considered indubitable algæ. Some of the opinions in that paper require modification, but no additional information has caused the opinion that they are not the remains of algæ, to be changed.

Two subjects of primary importance need to be discussed before any detailed examination of these problematic organisms can be made. These are:—I.—Absence of organic or carbonaceous matter. II.—Probability of the preservation of algæ.

I.—Absence of organic or carbonaceous matter.

The absence of organic matter in the fossil bodies under consideration makes it difficult to decide in many cases what they really are. Their mode of occurrence is usually on the under side of the strata as objects in relief. They are mostly of indefinite and quite variable form, so it is scarcely possible to find any two alike in details. Not only are organic *form* and organic *substance* absent, but the beds in which the greater part of the bodies occur are strikingly deficient in organic remains of any other kind, and while these may be and are abundant in strata both above and below, the beds themselves are nearly barren of any but the problematic fossils.

The absence of carbonaceous matter has been considered by some a strong argument against the vegetable nature of the remains; while the presence of it has, conversely, been regarded as indicating an undoubted vegetable origin. But on the one hand we know of organisms, of unquestioned animal origin, in which not a trace of organic matter is left, the impression or cast alone remaining; and we likewise know of unquestioned vegetable remains which are also in the form of casts; but which are so perfectly preserved that even the delicate venation can be studied and described.

On the other hand there are forms of animal origin, like the graptolites, in which there is abundant evidence of the presence of carbonaceous matter, just as there is in true plants, and some of the graptolites were originally referred to the vegetable kingdom on this account. So that it can scarcely be considered that the presence of carbonaceous matter makes the organisms plants; or that its absence militates against their vegetable nature. But, when the absence of definite form, of carbonaceous matter, of other organisms in the same beds of rock, and their occurrence in demi-relief on the under side of the strata; when all these are taken into consideration, it can

scarcely be denied that the probabilities are strongly against, not alone the vegetable nature of the remains, but also against their being the actual remains of animal forms.

The disposition to regard certain branching fossils as plants, even when all carbonaceous material was absent, has been very general because it was for a long time supposed that worm burrows would not show any tendency to branch. But it is now well-known, as was pointed out by Dawson in 1873, and in much greater detail by Nathorst in 1881, that many worm burrows are habitually branched. This differs, however, materially from the dichotomy of true plants, although it has been confounded with it.

II.—Probabilities of the Preservation of Algæ.

Under the head of the probability of the preservation of algæ in a fossil state, much can be said. It will perhaps not be denied by any geologist, no matter to which one of the two schools he may belong, that algæ must have existed throughout all geological time, and that, too, often in the greatest abundance. This has been insisted upon by Salter (Memoirs of Geological Survey of Great Britain, vol. 3, 1866): by Lesquereux in his various publications (2nd Geological Survey of Pennsylvania, Report J; also Coal Flora, Report P; 13th Annual Report Geological Survey of Indiana; Annual Report Geological Survey of Pennsylvania for 1886, etc.), and by others. The presence of masses of graphite in the Laurentian rocks; of oil and gas in the Trenton and Devonian periods, to say nothing of the mere fact that myriads of animal forms could not have existed without the presence of algæ, is sufficient proof that they once existed. But the questions are: Have they been preserved? What are the chances of their preservation? Are all the forms that have been described as algæ, really such? If not; to what can they be referred? What is their origin? The answer to some of these questions is final as regards certain of the problematical organisms; but the answer to the first two general questions has certainly not yet been given.

The opinion held by many students is frequently biased by the expressed opinion of the first observer or describer of a

fossil. It has frequently happened, therefore, that when a form has been described originally as a plant, this identification has been accepted by subsequent workers, and only after many observations have been made and many treatises written, does the original opinion change. This is well shown in the case of *Scolithus.* Originally described as a plant, it was retained for many years in the vegetable kingdom, and only after numerous investigators had examined it, was it definitely referred to the animal world.

To secure an answer to the query, "what are the chances for the preservation of algæ as fossils?" It becomes necessary to observe what is going on in modern oceans and the ocean margins to-day. In all favorable localities seaweeds occur in wonderful profusion. Some varieties live only between tide marks; others only below tide and to a depth of 15 fathoms; others at still greater depths, the growth of these deeper water forms, however, being limited by the penetration of light, vegetation ceasing entirely at depths between 100 and 200 fathoms. These plants occasionally form great masses in the eddies caused by oceanic currents, and cover many square miles of surface. This is the case with the Sargasso sea in mid Atlantic: the sea of kelp off the Falkland islands, and that off the coast of Japan. Some species are tough and leathery, and have thick stems and long fronds, some of these reaching a length of 300 feet. Some are fine and feathery, branching so as to form innumerable minute divisions. Some are hardly more than masses of jelly; and some are covered with a calcareous coating and are thus more or less hard and horny. The last class, however, are not numerous. They are known commonly as *Nullipores.*

The structural characters of the algæ as a class, are strongly against their preservation under any sort of cover for any long period of time. The tissue is a mass of loosely united cells, often with scarcely more than sufficient coherence to hold together; and even in the tough and leathery varieties, the cells have little consistence, are all of one character, and retain their form for only a short period when buried. The late Prof. Leo Lesquereux studied the possibilities of preservation of algæ,

and he reached the conclusion that marine plants are only rarely preserved in a fossil state. He based his deductions of past conditions upon present ones; and he noted that algæ are at the present time scarcely ever found in any good state of preservation. "The difference," he says, "between the woody or vascular tissue of land plants and the cellular compound of the marine or fresh-water algæ, mere filaments glued together, or imbedded in vegetable mucus or gelatine, explains at once why the remains of fucoids are so rarely found petrified." Further he says: "Nowhere have I been able to find any trace of a deposit of sea-weeds preserved from decomposition under any kind of superposed materials, sand, clay, etc. And, nevertheless in some of the countries visited, the shores in many localities are strewn with immense heaps of those plants thrown out by the waves. Marine vegetables, though they may appear of hard, leathery texture like most of the common species of Fucus, soon disintegrate, and pass into a gelatinous, half-fluid matter, which penetrates the sand, so that the lowest strata of these heaps when exposed to atmospheric action, do not generally preserve traces of their organism for more than one year."

While Lesquereux thus announces his positive belief, Mr. G. F. Matthew says that while the algæ buried in *sand* leave no trace, "in clay the result is different. In the Till and Leda Clays of the Acadian coast, which have considerable antiquity, the writer has seen Polysiphonias and other delicate sea-weeds as well preserved as the ferns and Asterophyllites of the shales of the Carboniferous system."

It is generally acknowledged that organic remains are more likely to be preserved in an area of subsidence than in one that is stationary or rising. Sediment is rapidly accumulated in the first, and animals living in the vicinity are likely to be preserved. It is also probable that animals living on or near the bottom of the ocean have a better chance of being entombed than those floating in the water, so that a certain depth of water and a comparatively rapid accumulation of sediment seem to be two necessary adjuncts for the preservation of organisms in anything like abundance or perfection. The so-

called "Fucoids," and the problematical organisms in general are mostly found in strata whose appearance indicates disposition in shallow water. Now this is in just the position where algæ might be expected to occur, but it is also the place where the chances of preservation are fewest. This seems to be conclusively shown by the almost complete absence of true animal remains from strata where the problematical organisms are most abundant. While fossils occur both above and below this horizon, and frequently in the greatest abundance, the actual layers where "Fucoids" are found are notorious for their barrenness. The fragments which *are* found attest the abrading power of the water and we again see the small chance cellular organisms would have of being preserved, when calcareous bodies of animals are ground to fragments.

On the other hand it should be remembered that shallow flats, exposed, it may be, to the air twice a day, or even covered with a slight depth of water, are admirably situated to receive and retain impressions left by crawling animal forms. Rain drop impressions, too, could be preserved, as well as mud cracks and the excavations made by rills of water on a sloping shore. These have all occured. Rain drop impressions, sun cracked earth, rill marks on the shore, and the burrows or trails of worms and molluscs, are all known from various geological horizons. But true algæ in the older rocks are rare indeed; and the most of those described as such take their place among the much discussed problematic organisms. The probabilities that true algæ are included among the long list of species referred to as plants is almost infinitely small; while on the contrary the chances that what have been so considered are referable to tracks, trails or inorganic causes, are almost infinitely great. Nathorst has pointed out that an algæ in sinking to the bottom of the water, if sufficiently solid to be preserved, would not make a *depression* in the mud, but rather an *elevation*. In reality the depression is what is found in the top of the stratum, while the elevation or cast occurs on the bottom of the next overlying stratum of rock.

CATALOGUE OF THE SHELL-BEARING MOLLUSCA OF PORTAGE COUNTY, OHIO.

By Geo. W. Dean.[1]

The following pages are the result of a somewhat industrious experience of about ten years, with the assistance of friends and experts, both within the state and outside of it. No pretence is made of completeness or perfect accuracy, for such a thing belongs to the impossibilities in the present unsettled and confused state of the nomenclature of this interesting department of the science of Natural History. This confusion is most striking among the fresh water univalves and the Corbiculidæ but it exists in nearly all the genera.

I have no doubt that species new to the county will yet be discovered. I predict that *Unio parvus* Barnes, and possibly *Margaritana hildrethiana* Lea, will be found in the south branch of the Mahoning in the township of Deerfield.

I think also that the Rissoids will be increased by the discovery of new forms.

My thanks are due to S. M. Luther and Geo. I. Streator for valuable aid.

Class GASTROPODA.

Sub-Class PULMONATA.

Order Stylommatophora.

Family Zonitidæ.

Genus *Zonites*, Gray.

Section *Hyalina* Ferrussac.

Zonites arboreus Say.

Common everywhere in woods and under logs. It is naturally an upland species, but it is often found in wet places.

Zonites nitidus Mull.

Not so common as the above but is often found in large numbers in wet places, subject to occasional overflow. This is the largest of our Hyalinas.

[1]Kent, O.

Zonites viridulus Mencke.

Wet and swampy grounds away from running streams. Not abundant.

Zonites indentatus Say.

Habitat moist woods. Not gregarious or abundant. A distinct and beautiful species.

Zonites minusculus Binney.

Rather rare. Damp old pastures around stumps and logs, sometimes in woods. I have found this species in four different localities but do not know how generally it is distributed.

Zonites milium Morse.

Habitat thick woods, in depressions among the moist leaves. Common, but not usually found in large numbers. The smallest of all our zonites.

Zonites ferreus Morse.

A northern species very rare in this latitude. A few examples have been collected by S. M. Luther and Geo. I. Streator in the vicinity of Garrettsville. I have compared it with specimens from Maine and have no doubt of its correctness.

Zonites exiguus Stimpson.

I have collected this species in considerable numbers in an open marsh near my place, under sticks and old fence rails. Not very common.

All of the above are found at Kent except *ferreus.*

Section *Conulus*, Fitz.

Zonites fulvus Drap.

Moist places, and very common.

Section *Gastrodonta*, Albers.

Zonites suppressus Say.

This species is not uncommon but has not been collected in large numbers. It is found in different situations but generally under leaves in moist woods.

Zonites multidentatus Binn.

Habitat same as the above. It is a very beautiful species and has been collected in large numbers by Luther and Streator near Garrettsville, rather common.

Section *Mesomphix*, Rafinsque.

Zonites fuliginosus Griffith.

Rather rare in this county so far as I have observed. On hill-sides in deep woods.

Zonites ligurus Say.

More common than any other species of mesomphix.

Zonites intertextus Binn.

Quite rare and has no existence in this part of the county. From Luther and Streator.

Zonites inornatus Say.

I have collected a few specimens of this species in Shalersville and Hiram townships, but it may be considered rare throughout the county.

Family SELENTIDÆ.

Genus *Macrocyclis* Beck.

M. concava Say.

Common. This genus has its greatest development in the Pacific States, but it is the opinion of Mr. Hemphill, whose field of observation has been very extensive, that all of the recognized species of that region are simply varieties of *concava*. Specimens of *concava* from Kentucky are found to very closely resemble the large forms of *vancouverensis* from Oregon and Washington.

Family HELICIDÆ.

Genus *Patula*.

P. solitaria Say.

Streator reports two localities where this species is found. I know of one. It is in woods on high ground in Hiram township. The shells are small but high colored for the species which is usually rather dull. Gregarious.

P. alternata Say.

A very common and abundant species.

P. perspectiva Say.

Also very common in rotten wood.

P. striatella Anthony.

Rather common in wet places liable to overflow. It resembles the preceding in appearance but is quite different in its choice of location.

Section *Microphysa* Albers.

M. pygmea Drap.

This minute species is not uncommon in woods among damp leaves, but it requires close search to find it.

Section *Helicodiscus* Morse.

H. lineatas Say.

Under old logs, in limited quantity.

Section *Strobila* Morse.

S. labyrinthica Say.

Rather rare in most localities. There is a small variety in my woods near Kent that is depressed and keeled.

Section *Stenotrema* Rafinesque.

S. hirsuta Say.

Very common in wet places.

S. monodon Rack. Var *fraterna.*

Common in woods.

Section *Triodopsis* Raf.

T. palliata Say.

Rather common on heavy soils. Absent on the light soils about Kent. Its habitat is about decaying timber.

T. inflecta Say.

Very rare in this county. More common in Sumit. I found two miles west of Akron a shell in every respect except size like the new species *T. craigini* Call, Kansas, and this leads to the suspicion that *craigini* may prove to be only an umbilicated variety of this species.

T. tridentata Say.

Common. Shells of this species and the following one are small throughout the county, only about 12 mm. greatest diameter while at Cincinnati and further south they are 18 mm. or more.

T. fallax Say.

Much like the above but not as common.

Section *Vallonia* Risso.

V. pulchella Mull.

Common. A circumpolar species common to three continents. The costate variety has not been observed here.

Section *Mesodon* Rafinesque.

M. albolabris Say.

Our most common species. The heavy variety prevails in the northern part of the county, sometimes with the parietal tooth. Only the small variety is found near Kent and this is uniformly without the tooth.

M. thyroides Say.

A common and very distinct species. Like the above the large variety is found only upon heavy soils, and the small variety at Kent.

M. profundus Say.

Not common and it does not occur at Kent. Fine specimens have been collected at Garrettsville and elsewhere.

M. multilineatus Say.

The large variety is rare and only found in the northern part of the county. The small variety is not uncommon at Kent. The variety *rufus* is occasionally found, but the plain unbanded variety so common in some places does not occur in the county.

M. sayi Binn.

A small variety of this species has been found along Tinker's Creek in Cuyahoga county, but only one specimen is known from this county. Collected by S. M. Luther.

M. dentifera W. G. Binney.

A single specimen reported from Hiram township by Mr. Luther. The determination may well be considered doubtful from the fact that there are so many forms of *albolabris* that this single specimen may be a sport or abnormal. It is the opinion of some well informed conchologists that *major*, *exoleta*, *andrewsi*, and this species are only some of its varietal forms. It is certain that the dividing lines are hard to find.

Family ACHATINIDÆ.

Genus *Ferrussacia* Risso.

F. subcylindrica Linn.

Not yet discovered in any numbers. A few isolated specimens only have been collected.

Family PUPIDÆ.

Genus *Pupa* Lam.

P. pentodon Say.

Most or all of the specimens I have seen are what is known as *P. curvidens* Gld. I have no doubt that both forms occur in the county. It is extremely variable and I do not with my present knowledge regard the latter as a distinct species. It is a common species and is found in localities very different in character.

P. contracta Say.

Common in wet places under decaying wood.

P. corticaria Say.

Inhabits bark of decaying logs as its name indicates. Quite rare here; I have only found six specimens in ten years.

Pupa edentula Drap.= *Vertigo simplex* Gould.

Not common. Attached to decaying wood and under leaves. Best time for collecting this species is late in the fall. *P. alticola* Ing. is probably identical with this.

Genus *Vertigo* Muller.

V. bollesiana Morse.

In swamps. Rare.

V. ovata Say.

Rather common in wet places on logs and sometimes stones.

V. milium Gould.

Abundant in some places on decaying wood and among leaves.

Family SUCCINIIDÆ.

Genus *Succinea* Drap.

S. ovalis Gould.

Very common.

S. avara Say.

Also a very common species. It is usually covered with a black wooly substance easily removed with a brush.

S. aurea Lea.

Not recognized here. Collected at Garrettsville by Mr. Luther.

S. obliqua Say.

Found sparingly in low grounds.

S. totteniana Lea.

Not common. This is the only succinea that I have collected on uplands. It is usually considered a variety of *obliqua*, but its decided green color and different habitat would indicate that it is at least as good a species as some others.

Family AURICULIDÆ.

Genus *Carychium* Müll.

C. exiguum Say.

An abundant species attached to bits of decaying wood in localities like the preceding.

Family POMATIOPSIDÆ.

Genus *Pomatiopsis.*

P. lapidaria Say.

Common along the borders of streams subject to overflow, along with *Z. nitida* and *Succinea avara.* This family is not usually placed among the Pulmonata. I give it this place because it is undoubtedly a land species.

Family LIMNÆIDÆ.

Genus *Limnæa* Lamark.

L. columella Say.

Not uncommon in stagnant water.

L. casta Lea.

A much smaller shell. Habitat the same and thought to be a variety of *columella.*

L. decidiosa Say.

Very common and abundant. Our smallest Limnea.

L. humilis Say.

Much like the preceding only a little larger, common.

L. caperata Say.

A more robust species than the preceding but almost equally common.

L. kirtlandiana Lea.

There is much confusion about this species. The type was evidently only about half grown. The mature shell is quite common and it may prove to be only a slender form of the following.

L. palustris Müll.

I do not know that this species has been collected here but I think it has and I have no doubt of its existence in the county.

L. reflexa Say.

I have not seen it here but Mr. Streator reports it rather common at Garrettsville.

Genus *Bulinus* Adanson.

Bulinus hypnorum Linn.

Not uncommon with habitat like the Limnæas in stagnant waters.

Genus *Physa* Drap.

Physa heterostropha Say.

If Mr. Say had placed everything under this head that he could not place elsewhere the result would be about what we find it; an extremely variable and abundant species.

Physa sayi Tappan.
Physa zordii Baird.
Physa ancillaria Say.

All found here and all may prove only varieties of *heterostropha*. I have collected the latter in Stewart's Lake together with *ancillaria* and more than half were doubtful as to which species they belonged. I regard *ancillaria* as only a variety.

Physa gyrina Say.

Equally variable with *heterostropha* and almost as common.

Physa ampullacea Gould.

Rare. This seems distinct but is said to be only a variety of *gyrina.*

Physa niagarensis Lea.

Reported by Streator from Camp Creek north of Garrettsville but I have not seen the shells. Shells collected at Akron for this species are undoubtedly *heterostropha.* The true *niagarensis* is very heavy and very white, and not half the size of *heterostropha.* Very uniform in size and appearance.

Genus *Planorbis* Guettard.

P. trivolvis Say.

Common but does not develop its full size here.

P. bicarinatus Say.

Common. Also small.

P. campanulatus Say.

Not uncommon.

P. corpulentus Say.

Doubtfully determined.

Section *Gyraulus* Agass.

P. albus Mull.

P. deflectus Say.

P. parvus Say.

P. exacutus Say.

All common.

Section *Segmentina* Fleming.

P. armigerus Say.

An abundant and very distinct species.

The following fresh water univalves are not classed with Pulmonata.

Family VALVATIDÆ.

Genus *Valvata* Mull.

V. tricarinata Say.

A very common species in streams.

Family STREPOMATIDÆ.

Genus *Goniobasis* Lea.

G. depygis Say.

Very common and abundant in all the larger streams.

Family Rissoidæ.

Genus *Bithynella* Moquin Tandon.

B. nickliniana Lea.

Known from Tinker's Creek only.

Genus *Amnicola* Gld. and Hald.

A. pallida Hald.

Tinker's Creek.

The two species last named were collected by Mr. Pettengell of Hudson and I can give no particulars about them.

A. porata Say.

A. parva Lea.

These two species are common at Kent.

A. cincinnatiensis Anth.

Lake Brady, Kent. The determination of this species is doubtful.

Family Paludinidæ.

Genus *Melantho* Bowdich.

M. integra Say.

M. decisa Say.

M. decisa var. *rufa* Hald.

All these and probably others are found in our streams but of there being more than one species I have grave doubts. Chas. T. Simpson the able Assistant Curator at the National Museum entertains the opinion that there is but one species of Melantho in the whole country.

Family Ancylinæ.

Genus *Ancylus* Geoffroy.

A. rivularis Say.

Adheres to stones and is common in many of the streams. Streator.

A. parallelus Hald.

Not uncommon in sluggish waters. Plentiful in the Cuyahoga river on stems of *Pontederia cordata*. Streator.

CLASS LAMELLIBRANCHIATA.

Family UNIONIDÆ.

Genus *Anodonta* Cuvier.

A. edentula Say.

A common and well marked species.

A. lacustris Lea.

Not common. Lake Brady.

A. ferrussaciana Lea.

Reported by Luther and Streator from Silver Creek. I have no means of knowing whether the determination is correct.

A. salmonea Lea.

Cuyahoga river near the Geauga line. This shell is identical with specimens from Ashtabula County that have been submitted to Geo. W. Tryon and Samuel H. Wright and identified as this species. The whole interior of adult specimens are colored a deep salmon, apparently caused by a constitutional disease of the animal. It is, in some places very abundant in sluggish streams.

A. subcylindracea Lea.

An abundant species in all of the larger streams.

A. pavonia Lea.

The typical form is rather common in the Cuyahoga river. A fine radiated variety is found in the Little Mahoning.

A. grandis Say.

I have fine large specimens of this species from a small stream in Windham township.

A. decora Lea.

This is a very beautiful shell but evidently only a smaller form of *grandis*.

A. fragilis Lam.

I am unable to see any value in this species. It is probably another form of *grandis*.

A. pipiniana Lea.

A set of this species is now in good condition, in the Lea collection at the National Museum from Lake Pepin in this township. Superficial examinations have not resulted in its re-discovery.

A. plana Lea.

Immense specimens of this species over eight inches long inhabit a small pond in Stratsboro township.

A. imbecilis Say.

Very rare here. One specimen from Lake Brady and one from a small pond in Franklin township. They have not the beautiful bluish green tint of Ohio river specimens. Recently Mr. Streator reports this species in considerable numbers from the Cuyahoga river in the north part of Hiram township.

Genus *Margaritana* Schum.

M. rugosa Lea.

This robust and plentiful species in the larger streams is comparatively rare here, but I have seen it in the Cuyahoga and it is probably found in Silver Creek and other tributaries of the Mahoning.

M. complanata Lea.

In Silver Creek, but not abundant.

M. marginata Say.

In Silver Creek and doubtless other branches of the Mahoning, but not very common.

Genus *Unio* Retz.

U. coccineus Lea.

Silver Creek, Windham township.

Unio gibbosus Barnes.

Silver Creek, Windham township. Common.

U. luteolus Lam.

Common and abundant in all the larger streams.

U. nasutus Say.

Common in many of the lakes and small streams and abundant in the Cuyahoga.

U. pressus Lea.

A very common species.

U. undulatus Barnes.

Silver Creek, Windham and doubtless other tributaries of the Mahoning.

U. occidens Lea. Branches of the Mahoning but not abundant. This form of *occidens* is identical with *U. subovatus* Lea.

Family Corbiculidæ.

Genus *Sphærium* Scopoli.

S. sulcatum Lam.
Common at Kent.
S. solidulum Prime. Kent.
S. striatinum Lam. Kent.
S. stromboideum Say.
Not common. Garrettsville.
S. occidentale Prime.
Not common. Kent.
S. truncatum Kingsly.
Kent. There is some doubt about the determination of this species.
S. fabalis Prime.
Fine specimens from Geo. I. Streator at Garrettsville.
S. securis Prime. Rare at Kent.
S. rosaceum Prime.
This species undoubtedly occurs here, but like the preceding is rare.
S. partumeium Say.

Genus *Pisidium* Pfr.

P. abditum Hald.
Found sparingly in swamps.
P. compressum Prime.
Abundant here in the Breakneck Creek. Fine large specimens.

THE CEREMONIAL CIRCUIT OF THE CARDINAL POINTS AMONG THE TUSAYAN INDIANS.

By J. Walter Fewkes.

During the progress of the secret ceremonials which are performed in the Kib-vas or Estufas at Hual-pi, and other pueblos of the old province of Tusayan, it is customary for a priest to pass on the north side of the fire-place as he approaches the altar, and on the south as he passes from the altar to the ladder. This custom is conscientiously followed by the older priests, especially when taking part in important ceremonials, and I have seen novices, and even old priests corrected and sent back when they had violated this simple kib-va custom. Has this usage[1] a meaning and if so what is it? I cannot answer these questions[2] satisfactorily, but I can show that the custom permeates most of their religious ceremonials, and that it makes its appearance in many different forms. It may shed some light on our knowledge of the meaning of this usage if some of the instances in which it appears in ceremonials be mentioned. Possibly kindred facts may suggest at least a theoretical explanation.

It is necessary at the very threshold of the subject to define the Hopi conception of the position of the cardinal points. The Hopi[3] or as they are generally called the Mokis have six points which they recognize in their ceremonial observances.

[1] This custom was almost simultaneously noted by myself and Mr. T. G. Owens in our work as members of the Hemenway Southwestern Archæological Expedition. Mr. Owens will later, in a publication on certain ceremonials which he especially studied, call attention to other examples of the ceremonial circuit which he has observed, and I shall describe it in detail in a memoir which I have in preparation.

[2] I have, however, the names of the Kat-chi-nas who are said to sit at each cardinal point.

[3] The priests at Hual-pi strongly object to being called "Mokis." Mo-ki in their language means "dead." Their true name is Ho-pi-tuh-shi-nuh-mo, peaceful people, Shi-nu-mo simply meaning people. The Mexicans are called Kas-til-shi-nu-mo; Navajos, Ta-shab-shi-nu-mo, etc. I have not found a hieratic and demotic language, among the Hopi, and therefore cannot follow Bourke's suggestion as to the possible origin of the "ancient language." There are many archaic words as in the song sung by the Antelope priest, Tci no at the Snake Dance, but he himself says that he does not understand the meaning of the words.

They have the four cardinal points to which are added up and down. These directions are always mentioned by them in the following order: north, west, south, east, up and down. Our remarks deal with the four points first named.

These four directions strangely enough do not correspond with the true cardinal points. The so-called Kwi-ni-wi-ke of the Hopi is neither the magnetic nor the polar north, but about northwest, or 45° west of north, and the other points vary in the same ratio. Their cardinal points therefore are really northwest, southwest, southeast and northeast. It does not seem in place here to discuss why these people or their priests have chosen these as their ceremonial cardinal points. I believe a ready explanation is found in the orientation of their kib-vas, which in turn depends on the extension of the mesa[1] upon which Hual-pi is situated. It is true that none of the kib-vas in this pueblo are oriented north and south by the meridian, but all five are placed northeast southwest. The ceremonial[2] part of the kib-vas is therefore situated at the southwest end and the spectator's region on the northeast.

Consider now that the walls have the position which they do, and one can readily see, I think, why the position of those walls should determine the ceremonial cardinal points.

The relationship of colors to the cardinal points, which differs among American races, varies slightly in the two pueblos Hual-pi and Ha-no, Tusayan towns situated only a few hundred yards apart on the same mesa. It must be remembered however, that the people of Ha-no are Western Tewans and not true Hopi. This fact is interesting as showing how tenacious the Tusayan Tewans are, not only of their language but

[1] Or speaking more accurately, on the direction of the lines of fissure of the rock of which the mesa is built up. Studies of the kib-vas of the other mesas would throw light on this point.

[2] By the ceremonial part of the kib-va is meant that portion surrounding the Si-pa-pu or opening symbolic of the opening, out of which in the time of the ancients, the races of men emerged. This opening does not exist however in all kib-vas, but it is easy to recognize the ceremonial part in such by the position of the fire-place. The visitor's portion is always raised a few inches above the ceremonial region and it is upon it that one always steps as he passes from the ladder into the chamber of the kib-va.

also of minor religious conceptions. I have found the same to run through many of their customs and beliefs.[1]

In a comparative study of the directional colors of the Hopi with those of other tribes we must remember that yellow corresponds not to north or west, speaking of the true direction, but to northwest. The following colors correspond to the four cardinal points, [calling to mind that the Hopi north is really northwest,] north, yellow; west, blue [represented ceremonially by malachite green[2]]; south, red; east, white. The reason I translate their word *kwi-ni-wi-ke* for the first direction, north, is because they say their north is the same as the American, but differs from it in direction. At Ha-no the colors are the same except that yellow north, and blue west are interchanged; with them north is blue and west is yellow as among eastern Tewans according to Bandelier. In what follows I confine my remarks to the conception of colors and directions used by the Hopi of Hual-pi.

Whenever these four colors are used symbolically they are used in the same order: yellow, blue, red and white. Whenever offerings are made to the four cardinal points they are made in the corresponding circuit, north, west, south and east. Let me cite a few examples of each which may illustrate, possibly establish, my position.

The ceremonial circuit is constantly followed in the preparation of so-called medicine. When a priest pours the liquid of which it is made into the terraced rectangular bowl, preparatory to placing the other ingredients in it, he pours the fluid first on the north side, then on the west, then on the

[1] A most interesting problem is suggested by the proximity of peoples of Hopi and Tewan descent. The time when the Tusayan Tewans separated from the eastern branch is known historically and tradition tells us why they chose the site for their town which they now occupy. Bringing with them their own mythology they found a similarity between it and that of the Ho-pi, and at once recognized the equivalents of their mythological conception. It would be an interesting research to study the linguistics of the Tusayan Tewans as compared with the eastern to determine the character of the modifications brought about in two centuries, and to find out in these instances where the eastern and western branches have a common name for a deity what Hopi mythological personage the Tusayan branch regard as the equivalent.

[2] When green is mentioned in this article, blue is the color which is in reality meant. Malachite gives a convenient material for paint and, when ground, for sand mosaics, but when used represents blue, I think, in all cases. Diamond dye blue, symbolic of the west, is sometimes used in the ornamentation of dolls or te-hus.

south and then on the east side of the bowl. This I have repeatedly seen performed by many different priests. I have witnessed it in the kib-va exercises of the farewell [*Ni-man*] kat-chi-na, the secret exercises performed by the antelope assemblage at the time of the Snake Ceremonials,[1] in the observances of the flute fraternity and in the cryptic celebration of washing the snakes, which occurs at noon on the day of the Snake Dance. In all instances the liquid is poured into the medicine bowl in the sequence of cardinal points mentioned above. When the sacred meal and cornpollen is added to the liquid in the bowl the same circuit is followed, the priest first throwing a pinch to each point before placing another in the bowl itself. When, as in the *Ni-man kat-chi-na*, the priest, In-ti-wa, washes the crystals and shells from the six ears of corn into the medicine, he takes up first the corn ear at the north of the bowl and then the others in ceremonial circuit. When these ears of corn were laid in their radiating position which they occupy about the bowl, the same sequence was followed and when the rock crystals were placed upon each ear the same law was followed. The greatest care is always exercised when ingredients are placed in the medicine bowl during a ceremony to follow the law indicated.[2]

The ceremonial circuit of the cardinal points is also followed in those observances in which asperging takes place. During the complex ceremony in the Mung-kib-va, performed by the antelope priests at the celebration of the Snake ceremonies, Ha-hau-ly, the pipe lighter, dips his aspergill into the medicine bowl while the traditional songs are being sung and after asperging the sand mosaic altar throws medicine to the north, then to the west, then to the south and then to the east. This he does in each of the sixteen songs which the antelopes sing continuously in this ceremony.

[1] A memoir on the nine days ceremonial known as the Tcu-a-ti-ki-bi, the last day of which has been often described as the Snake Dance, in which the observances and the traditions connected with them will be considered, is in course of preparation by Mr. A. H. Stephen and the author.

[2] Most interesting illustrations of the ceremonial circuit occur in the cryptic celebration of "Washing the Snakes," prior to the last day's celebration of the Snake Dance, and in the preparation of the liquid (medicine), used by the Snake priests in the manufacture of the clay pellets which they wear tied to their bandoliers.

The instructive ceremonies which take place on the morning following a celebration known as the Ni-man kat-chi-na to which reference has already been made, and which I have witnessed in two of the Tusayan pueblos, have many examples of the law of the circuit of the cardinal points. It is customary at this time for four persons, three of whom are dressed as Kat-chi-nas, to stand facing the kib-va entrance at the four cardinal points. At a certain time the leader walks around the kib-va entrance, throwing a little water to each of the four directions. After him follow the others, but all move about the kib-va opening in a direction opposite the hands of a watch. Later the same persons march around the entrance to the kib-va and pour liquid into a bowl held up by a priest who stands on the lowest rung of the kib-va ladder. In performing these and similar services they pass in the same direction, and all ceremonies involving the four points begin at the same side which is always that referred to as the Hopi north. All the offerings which the kat-che-nas hand into the kib-va, and all those which the priest within throws out follow the same ceremonial circuit which I have described. The priest himself inside the kib-va, in casting the meal out of the entrance upon the Kat-chi-nas, observes the same order. Later in this observance, when the kat-chi-na chief emerges from the kib-va to accompany those outside to the crypt in which the offerings are deposited, he stands on the roof of the hatchway of the estufa and throws a pinch of meal first to the north, then to the west, then to the south and last of all to the east. The other priests who follow do the same, and there are many instances where offerings are made in the same circuit in this instructive service which celebrates the departure of kat-chi-nas or "sitters" to their home in the Francisco Mountain. I have observed the ceremonial circuit in the formal smoking which precedes and follows most kib-va observances. I have watched several of the more conservative priests in the ceremonial smoking,[1] and

[1]Many interesting things might be mentioned in regard to the ceremonlal smoktng among the pueblos, not the least interesting of which are the methods of passing the pipe and the terms of relationship exchanged, their interpretation of the act of smoking and the love connected with it, but I reserve this for a more extended account.

have always noticed that after having puffed the smoke upon the sacred things on the altar, they send a whiff to each of the cardinal points in the ceremonial circuit.

In the midst of some of the most sacred ceremonies of preparation of medicine it is customary in certain observances to make four marks with sacred meal on each wall of the house, on the ceiling and floor. During the midnight exercises of the Flute Observance and in the woman's dance, La-la-kon-ti, as well as in several other ceremonies this has been observed. When the priests make their four marks on the walls, they always begin with the north and follow the ceremonial circuit, ending with the floor.

In the Snake Celebration the planting of the prayer plumes is entrusted to one of the four chiefs of the antelopes, who places four each day in appropriate shrines, one at each of the four cardinal points. To do this he makes a course around the mesa, the radius of which diminishes each day until the last when he does not leave the top of the mesa itself. In making these runs to deposit the plumes he follows the ceremonial circuit, beginning with the shrine at the north and ending with that at the east.

The snake priests plant their prayer sticks and hunt on four consecutive days for the snakes used in the dance, first to the north, then to the west, then to the south and finally to the east of the mesa on which the pueblo stands.

It is the custom of the Tusayan pueblos to celebrate a solemn ceremony at the time of the Flute Festival[1] in which the cloud god, O-man-a, personified by one of their priests, deposits prayer plumes in the bed of their large springs and takes offerings from the same. At a most impressive time in this ceremony he wades about the spring, neck deep in the water, four times each in the direction necessitated by the ceremonial circuit.

[1] This celebration lasts nine days and is observed on alternate years with the Snake Dance in Hual-pi and Mi-shon-o-vi. It was observed last summer in Shi-pau-lo-vi, Shi-mo-pa-vi end O-lai-bi. I had the good fortune to study it in the first mentioned pueblo and to be initiated into the priesthood in that place. The last day of the celebration called the Ley-la-tak I have partially described in another place (Journal of American Folk Lore, a Suggestion as to the Meaning of the Moki Snake Dance).

The above are but a few of many examples which might be mentioned of ceremonies in which the circuit is followed. The evidence from the use of colors substantiates that already given above. The priest of the Antelope Assemblage, in making the sand mosaic picture in the Mung-kib-va a few days before the Snake-Dance, first makes the yellow border, then the green, then the red and then the white.[1] The north line of the yellow is followed by the west of the same color, then the south and then the east. The same sequence of colors occurs when he outlines and makes the body of the semicircular clouds in the centre of the mosaic (dry painting). The lightning serpents of the four colors are made in the same order of the colors. Colored disks on small bushes are thrown into the kib-va by the four persons who stand outside on the morning after the *Ni-man-kat-china.* First the yellow, then the green, then the red and then the white disks are thrown in in this observance.[2]

In the construction of a pathway of sand and meal across the floor in the Flute Festival four materials are used which correspond with the cardinal points. They are laid on the floor in the sequence corresponding to the ceremonial circuit, north, west, south and east.

Six bird effigies are laid along this line composed of sand, fine meal, coarse meal and corn pollen. These bird figures correspond with the cardinal points, and that named for the north is placed in position first, the others following the ceremonial circuit.

It is interesting to note that the ceremonial circuit is opposite that of the sun in its daily course in the sky. It is proba-

[1] Wi-ki, the Antelope priest, is not always careful to follow this order in placing the colored sands in the sand mosaic (dry painting), but that order is intended, and is generally followed.

[2] The association of colors of opposite directions in certain ceremonials is interesting. For instance in these disks the four white are spotted with green dots, the four green with white, the four yellow with red and the four red with yellow spots. In the same way the four rattlesnakes on the black border of the sand mosaic of the snake assemblage in the snake dance have the head and body of the white snake marked by a green border, the green snake with a white, the yellow with a red, and the red snake with a yellow outline. The same is true of the necklaces of the snakes when present, and the lines indicating rattles. In the lightning snakes of the altar of the antelopes these zigzag figures both male and female have a black border.

bly more than a coincidence that it is the same circuit which the snake and antelope priests take when they move about the place, and where the latter carry the snakes in their mouths. It is generally the same circuit adopted by some of the Kat-chi-nas when they turn in the dances, viz: opposite the motion of the hands of a watch.[1]

It is not possible in a short notice to develop the idea of a fixed ceremonial circuit which is rarely violated. To do so as I would wish, necessitates long descriptions of ceremonies, the names even of which are new to ethnological students. It is possible here to hardly do more than make the barest statements, which will later be substantiated when the ceremonial events are minutely described. The custom of entering and leaving a kib-va, or of passing the fire-place on a certain side is but one illustration of a law which finds expression throughout all the religious customs, secret and public, of the Tusayan Indians. It would be interesting to see whether other American races have the same ceremonial circuit of the cardinal points. My reading has shown me that in some instances they do not.

[1]It is not however always the direction in which the Kat-chi-nas turn in their dancing, for often they turn half way around in this direction and then return to the same position in an opposite way. Upon this point more observations are needed. In most instances it is the course which the procession of Kat-chi-nas follow in Hual-pi when they march from one place to another, between dances. While there are a few exceptions to the law of ceremonical circuit they are not numerous enough to indicate the existence of any other direction of the circuit.

THE ASH-GRAY HARVEST-SPIDER.

By Clarence M. Weed, D. Sc.

The Ash-gray Harvest-spider (*Phalangium cinereum* Wood) occurs over a large portion of the northern United States, and is the species most commonly found about sheds and outbuildings. It is the only one of the harvest-spiders described by Say and Wood that is still retained in the genus Phalangium.

LITERATURE.

This species, like many others of the family, was first described in Dr. Wood's paper published in 1868 in the Communications of the Essex Institute (vol. vi, pp. 25–26, 39; fig. 5) under the name by which it is yet known. The author had received a large number of specimens collected in northern New York.

Aside from a bibliographical reference by Professor Underwood, occurring in the *Canadian Entomologist* in 1885 (vol. xvii, p. 168), no notice of the species appears in our literature until October, 1887, when the present writer called attention, in the American Naturalist (vol. xxi, p. 935), to the fact that this species comes properly in the genus Phalangium as restricted by Simon. Two years later I again treated of the species in my Descriptive Catalogue of the Phalangiinæ of Illinois (*Bull. Ill. St. Lab. Nat. Hist.* vol. iii, pp. 93–94), publishing extended descriptions from specimens collected in Central Illinois and Southern Michigan. It was also briefly mentioned in my paper on the Harvest-spiders of North America in the American Naturalist for October, 1890 (vol. xxiv, p. 916) where it is said to occur in the northern states from New York to Nebraska.

LIFE-HISTORY.

The Ash-gray Harvest-spider passes the winter in the egg state. A few years ago in Illinois I found a bunch of about a dozen small, white, spherical eggs, slightly beneath the soil surface, which were transferred to breeding cages. During the spring they hatched into small, gray phalangids which were

PLATE I.

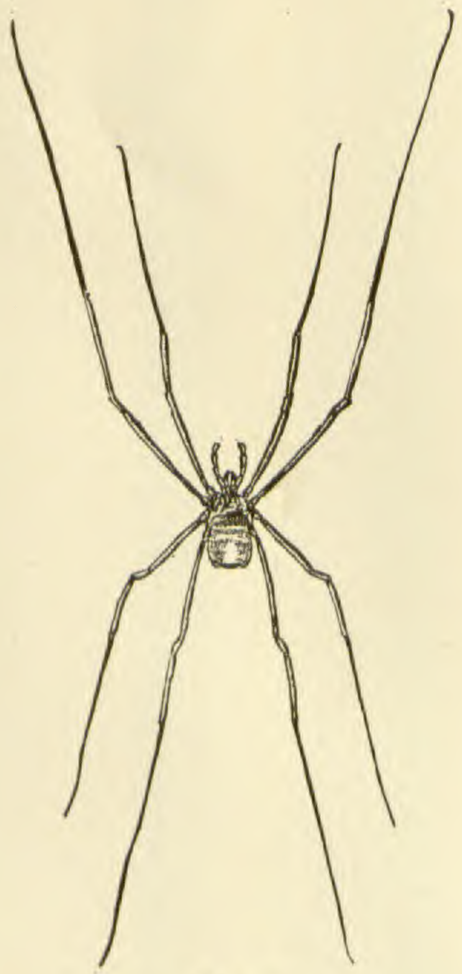

Fig. 1.

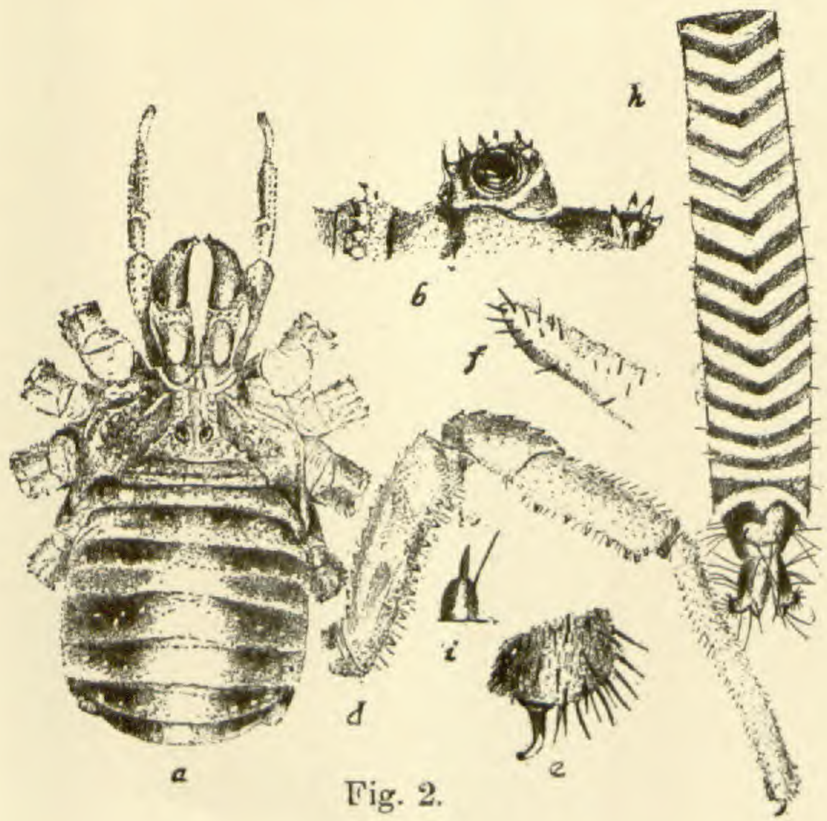

Fig. 2.

Phalangium cinereum Wood.

believed to belong to the present species. I have never seen the female engaged in oviposition, but the structure of the ovipositor (Fig. 2, h) indicates that the eggs are deposited in the ground, about half an inch below the surface. In the latitude of central Ohio there are apparently two broods each season, the first maturing late in June or early in July, and the second, which is much the more numerous in individuals, in September.

This species is preeminently what may be called an in-door species. It abounds especially in sheds, out-houses and neglected board piles, being rarely found, so far as my experience goes, in the open field. Its color especially fits it for crawling over weather-beaten boards, making it inconspicuous against such a back-ground. During the day it is usually quiet, but at dusk, and on cloudy days, it moves about quite rapidly. It probably feeds upon small flies and other insects that it finds during its nocturnal rambles. The only natural enemies that I have seen it suffering from are the web-making spiders, in the webs of which it often perishes, often getting its long legs inextricably entangled.

DESCRIPTION.

The following descriptions have been drawn up from a long series of specimens collected over a wide range of territory.

MALE (Fig. 1; Fig. 2, *a*, *b*, *d*, *e*)—Body, 5–6·8 mm. long; 3–4 mm. wide. Palpi, 4 mm. long. Legs, I, 23–33 mm.; II, 44–52 mm.; III, 24–33 mm.; IV, 31–42 mm.

Dorsum ash-gray, with a slightly darker, sub-obsolete, wide, vase-shaped, central marking; in some specimens entirely obsolete; with transverse series of small spinose tubercles behind the eye-eminence, one row on posterior border of cephalothorax, and one on each abdominal segment except last two, and a curved series in front of eye-eminence. These tubercles (Fig. 2, *h*) have whitish bases, and acute black apices, and also generally have a spinose hair arising on one side near the apex of the white portion, and reaching beyond the tip of the tubercle. In front of the eye eminence there are two longitudinal series of these tubercles of three each. Lateral borders of cephalothorax, subsinuate. Eye-eminence low, canaliculate, with a series of five or six tubercles like those on the dorsum surmounting each eye. Mandibles brownish-white, tips of claws black; second joint and apical portion of first joint furnished with short, black, stiff hairs. Palpi light brown, rather slender, first four joints with minute tubercles and short black hairs: none of the angles prolonged; tarsal joint without tubercles, but with hairs; claw moderately robust. Venter including coxæ, light grayish-brown, with many somewhat quadrangular patches of a more pronounced brown, and scattered blotches of chocolate brown. Trochanters

light brown, with many small tubercles. Remaining joints of legs cinnamon brown, more or less annulated with deeper and lighter shades; angular with longitudinal rows of black spines. Sheath of genital organ subcylindrical, truncate; shaft robust, with two lateral, oval openings near distal extremity, then contracted into a blunt scoop-shaped piece, turned upward at nearly a right angle, and terminating with a slender acute point.

FEMALE (Fig. 2, *g*, *i*).—Body, 6–9 mm. long; 4–5 mm. wide. Palpi 4 mm. long. Legs: I, 21–29 mm.; II, 39–52 mm.; III, 22–29 mm.; IV, 30–37 mm.

Differs from the male as follows: Body larger, rounder. Dorsum darker gray, more mottled; central marking more distinct. Tubercles on dorsum smaller; those on eye-eminence more numerous, and those forming the longitudinal series in front of the eye-eminence also more numerous. Palpi with hairs but without tubercles. Legs with annulations more distinct; trochanters without tubercles; spines on femur less prominent and on tibia obsolete. Narrow quadrangular brown patches on venter of abdomen arranged in transverse series. Distal joints of ovipositor blackish; about thirty in number.

VARIATION.

Like most members of its family the Ash-gray Harvest-spider varies greatly in the size of its body and the length of its legs. To determine the extent of this variation, I collected at Columbus, Ohio, about the middle of September, 1889, a large number of adult specimens of both sexes, which were carefully measured by my assistant, Miss Freda Detmers. The results are shown in the tables on pages 35 and 36.

These tables show a remarkable amount of variation on both sides of the line of average. It will be noted that the difference between the greatest and least measurements averages about one-third the entire length of the latter in both sexes; and that only two cases occur in each table where the leg measurements are identical, viz: Nos. 5 and 13, and 7 and 25 in Table I; and 16 and 20, and 23 and 25 in Table II. These facts indicate how readily this family of long-legged spiders could have been developed from allied forms with shorter legs.

DISTRIBUTION.

Dr. Wood states that this species was found abundantly in northern New York. Specimens in my collection represent the following counties of the states named:

ILLINOIS: Champaign.

IOWA: Story (C. P. Gillette).

MAINE: Penobscot (F. L. Harvey).
MICHIGAN: Ingham (H. E. Weed).
NEBRASKA: Lancaster (Lawrence Bruner).
NEW YORK: Tompkins (J. H. Comstock: N. Banks).
OHIO: Butler, 1 September, 1890; Delaware, 18 September, 1890; Erie, 5 July, 1890; Franklin, 4 October, 1890; 18, 20, 21 September, 1889; 18 October, 1889; Lawrence, July, 1889; Madison, 21 July, 1890.
SOUTH DAKOTA: Brookings (J. M. Aldrich).

Variation of Phalangium cinereum. Table I. Male.

No. of Specimens	Length of Body.	Length of Legs.				Remarks.
		First Pair.	Second Pair.	Third Pair.	Fourth Pair.	
	mm.	mm.	mm.	mm.	mm.	
1		27	49	26	31	Body not meas'd.
2		26	49	27	36	" " "
3		29	51	29	39	" " "
4		31	55	32	40	" " "
5		30	54	30	39	" " "
6		23	44	24	32	" " "
7		29	54	30	39	" " "
8		27	49	27	36	" " "
9		30	54	30	40	" " "
10		26	47	26	35	" " "
11		33	59	33	42	" " "
12		25	46	26	34	" " "
13		30	54	30	39	" " "
14		28	49	27	36	" " "
15		29	54	29	38	" " "
16		32	57	32	41	" " "
17		25	47	25	34	" " "
18		31	55	31	40	" " "
19		29	53	29	40	" " "
20	5·8	28	51	28	36	
21	6·8	31	56	31	41	
22	5·2	27	50	28	37	
23	5·	27	49	28	37	
24	5·4	27	48	27	36	
25	6·2	29	54	30	39	
26	6·	29	55	30	41	
27	5·	27	50	27	37	
Average.	5·6	28	52	29	37	
Shortest.	5·	23	44	24	31	
Longest.	6·8	33	59	33	42	
Difference	1·8	10	11	9	11	

Variation of Phalangium cinereum. Table II. Female.

No. of Specimens	Length of Body.	Length of Legs.				Remarks.
		First Pair	Second Pair.	Third Pair.	Fourth Pair.	
		mm.	mm.	mm.	mm.	
1	5·9	24	44	24	34	
2	7·	23	44	24	34	
3	7·	24	47	25	36	
4	7·2	22	43	24	33	
5	7·4	22	45	23	34	
6	9·4	24	46	25	34	
7		22	42	22	31	Body not meas'd.
8		29	52	29	38	" " "
9		21	43	22	32	" " "
10		25	47	26	35	" " "
11		25	46	25	34	" " "
12		24	47	26	35	" " "
13		22	43	23	32	" " "
14		24	45	25	35	" " "
15		24	48	26	35	" " "
16		22	42	23	32	" " "
17		24	48	25	36	" " "
18		22	41	22	33	" " "
19		23	44	24	34	" " "
20		22	42	23	32	" " "
21		21	39	22	30	" " "
22		26	49	27	37	" " "
23		23	43	23	33	" " "
24		23	40	23	31	" " "
25		23	43	23	33	" " "
Average.	7·3	23	45	24	33	
Shortest.	5·9	21	39	22	30	
Longest.	9·4	29	52	29	37	
Difference	3·5	8	13	7	7	

EXPLANATION OF PLATES.

Fig. 1.—*Phalangium cinereum*, male natural size. (Original F. Detmers, *del.*)

Fig. 2.—*Phalangium cinereum*, structural details: *a*, body of male, back view; *b*, eye eminence of male, side view; *d*, palpus of male, side view; *e*, claw of palpus of male, side view; *f*, maxillary lobe of second legs, of female; *h*, apical joints of ovipositor; *i*, dorsal tubercle of male—all magnified. (Original, F. Detmers, *del.*)

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DAWSON, G. M.—On the Later Physiographical Geology of the Rocky Mountain Region in Canada, with Special Reference to Changes in Elevation and the History of the Glacial Period. Extract from Trans. Roy. Soc. Can., Vol. VIII., Sec. 4, 1890. From the author.

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DEPERET, M., et F. LEENHARDT.—Note sur la Dècoverte de l'Horizon du Montaignel, a Bulimus hopei dans le Bassin d'Apt. Extrait de la *Bull. Carte Geol. de la France*, No. 16, Tome II. From the authors.

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RECENT LITERATURE.

Report of the U. S. Fish Commission for 1887.—This report is an illustration of the delays experienced by those having work to be done by the Government printing office in Washington. Were it not for the circulation of separate copies in advance, the scientific part of the report might be anticipated several times. Now that it is here, we can congratulate Hon. Commissioner MacDonald, on the value of the work. An account of the fisheries of Lakes Erie, Huron and Michigan comes first. It is illustrated by several excellent cuts of important food fisheries. Descriptions of the Albatross and Grampus vessels of the commission follow, with itineraries of their latest voyages. These are admirably illustrated. Then follows a monograph of the species of Labridæ of the seas of the Western Hemisphere, by Prof. D. S. Jordan, which is of the most thorough character, without going beyond the usual systematic features. It is illustrated by numerous excellent figures. The last essay is a long one by Prof. Linton,

on Plathelminthic Entozoa observed by him in various species of North American fishes. Many remarkable forms are described among which are many novelties, not a few of which are referred to new genera. We give some of the illustrations from the Report, through the kindness of Col. MacDonald.

A Catalogue of the Birds of Indiana.—By Amos W. Butler. This excellent catalogue of Indiana birds by this well-known student of the vertebrate fauna of that State is a welcome addition to the Natural History of the region discussed. In this publication is presented in condensed form the results of the author's observations covering the greater part of fourteen years. For a number of years these observations have been conducted as curator of Ornithology of the Indiana Academy of Science. In addition Mr. Butler has had the earnest co-operation of almost every naturalist in the State or who has studied within the State, prominent among whom may be mentioned Prof. J. A. Allen, Mr. Robert Ridgway, Dr. C. Hart Merriam, Prof. B. W. Evermann, Mr. Ruthven Deane, Mr. W. K. Coale, Dr. F. W. Langdon, Mr. E. R. Quick and a number of others, each of whom is duly credited for his contributions. This catalogue has been published in the Proceedings of the Indiana Horticultural Society for 1890, and the Society is to be congratulated upon its success in presenting so pleasing a publication. The list enumerates 305 species which have actually been found in Indiana, and gives a "Hypothetical list" of 79 species "which have been taken in neighboring States or whose known range seems to include Indiana." The care exhibited in the preparation of these lists is notable and considering the condensed form of the publication, the annotations are good and give much new information concerning the birds of the state. Following the introduction (which contains a brief account of the topography of the State, and a copy of the law "for the protection of Birds" passed by the last state legislature) is a "Bibliography of Indiana Ornithology." Next is given the Catalogue which is illustrated by numerous cuts from Coues's "Key to North American Birds," then the hypothetical list, followed by a list of the persons who have assisted by contributions in the preparation of the Catalogue. In conclusion is a carefully prepared index to the whole work. One can but wish that all publications of this kind were as convenient as this one, and that all of our States had a catalogue of their birds so well presented.

General Notes.

GEOGRAPHY AND TRAVELS.

At the meeting of the Society of American Naturalists, held in Philadelphia, Dec. 30, 1891, reports from four exploring expeditions were read. The following abstracts of them appeared in the Philadelphia *Ledger* soon after:

The Galapagos Islands.

Prof. George Baur, of Clark University, Worcester, Mass., presented his report on his expedition to the Galapagos Islands, in the South Pacific Ocean.

The expedition left New York May 1, on the steamship City of Para, most of the funds for which having been provided by Mr. Stephen Salsbury, one of the trustees of Clark University, a contribution from the Elizabeth Thompson Fund of Boston, Prof. H. F. Osborn and others.

The expedition reached Chatham Island, one of the group, on June 9th. Here they remained over two weeks, during which extensive collections were made. Great differences were noted in the climate between the upper and lower portion of the island. In the former it was nearly always damp, rain falling nearly every night and day; while, in the latter, it was very agreeable, and rain seldom fell.

On the 27th of June the expedition left Chatham Island, and reached Charles Island the next day.

Before going on the expedition, Prof. G. Baur had announced the conclusion that the Galapagos Islands were, contrary to the general opinion, to be considered as continental; that they developed through subsidence, and not through elevation by volcanic activity. This conclusion led him to the establishment of the two following theses:

First. Continental islands must have a harmonic distribution of fauna and flora.

Second. Oceanic islands must have a disharmonic distribution.

From all that is known about the Galapagos Islands, it appears that the distribution was harmonic.

Charles Island was the first taken for comparison, and here everything seemed quite different from Chatham. The hills were more rounded, and there was very little indication of more recent volcanic eruption. The rocks were more decomposed, but more dry than Chatham. The composition and aspect of the flora were different. Many of the large trees of the upper region of Chatham were totally absent.

The composition of the fauna was also different. As in Chatham, the members of the expedition made large collections on Charles Island, and, as on that island, the birds were very tame, especially the small birds.

"Very often," said the Professor in his report, "the small birds alighted on my hat or gun when I kept quiet."

As an illustration of how tame the birds were, Prof. Baur related the following:

"I was watching a lizard, when a species of *Buteo*, alighted on a little bush about three feet from me. I had with me a small switch, and began to tickle him over the head, neck and body. This he seemed to like very much, not showing any fear whatever. After this I went to a small island a few yards away from the spot. I had hardly arrived there when the bird came over, alighted near me and allowed itself to be tickled again."

The birds are restricted to the single islands, and on each of them are but few species of a genus, and the land-birds at least never seem to travel from one island to another.

"Tortoises were extinct on Charles Island long ago. They are also extinct on Chatham, Barrington, Hood, and Jeans, on which islands they formerly existed. No tortoises were ever found on Tower and Brindloe.

"On South Albemarle, where we remained nearly three weeks, we secured quite a number of specimens. Here the tortoise is still numerous.

"The large and high islands of the group show the richest flora. In the flora were found the same differentiation on the different islands as in the fauna, so far as could be observed."

The report concluded about as follows:

"There cannot be any further doubt that the distribution of the flora and fauna of the Galapagos Islands is absolutely harmonious. It is this harmony in the distribution which has led me to the theory that the islands are continental and not oceanic. How could we explain by the theory of elevation, now generally accepted, harmonious distribution? It is simply an impossibility to give any explanation on this theory. The theory of subsidence, however, makes every point clear at once. All islands were connected together at a former period. At this time the number of species must have been small. Through isolation into single islands, the peculiar specialization of the species which we found began—an originally single species was differentiated in many

different forms. Every, or nearly every, island developed its peculiar races.

"Now, after it has been shown that the Galapagos Islands are continental islands, the question arises, How about other continental groups which are generally considered to-day of oceanic origin? How about the Sandwich Islands and the others in the Pacific Ocean? And how about the theory of the constancy of the ocean basins? Is this theory on a sound basis? I do not think so; and I am glad to say that this theory has been doubted recently by eminent geologists.

"But geology seems to be unable to give a definite answer. Here biology came to help by a detailed study of the organisms of the different groups of islands and their geographical distribution. I think it will nearly always be possible to determine whether the groups have originated through subsidence or through elevation. In the first case we will find harmony; in the second case, disharmony.

North Greenland Expedition.

Prof. Heilprin followed with a report of the expedition sent out last June by the Academy of Natural Sciences to Greenland. He reviewed the journey from Disco to McCormack Bay, where Lieutenant Peary and his party were left. He described the town of Godhavn, and gave a vivid word-picture of the bleak coast of Greenland. He told minutely the story of the struggle with the ice-pack in Melville Bay, and described the appearance of the great ice sheets and of the huge icebergs met with. He also gave a sketch of the place where Lieutenant Peary built his headquarters, and what he expected to accomplish. Prof. Heilprin also reported briefly on the valuable collections made, and of the otherwise successful results of the expedition.

Labrador's Fauna and Flora.

Prof. L. A. Lee, of Bowdoin College, Brunswick, Me., made a report on the scientific expedition to Labrador last summer, under the title of "Scientific Results of the Bowdoin College Expedition to Labrador." The party consisted of nineteen persons, mostly graduates of the College, and left Rockland Me., on the 27th of last June, returning September 24. Most of the time was spent on the coast of Labrador, between the Straits of Belle Isle and Hopedale, Latitude 55° 27′ North. Much dredging was done along the coast, which brought to light abundant species of molluscs and crustacea, many of them new to the known fauna of the country.

In the mouth of Hamilton Inlet a true deep-sea deposit was found in fifty fathoms of water, where the bottom consisted largely of the

shells of arenaceous Foramenifera, like *Hyperammina*. The number of known species of fish was doubled, and specimens were secured of a remarkable deep-sea *Plagyodus*. In archæology a very interesting discovery was made of the remains of an ancient Esquimaux village, among the refuse of which were found many bone implements, ornaments and carvings of ivory.

The work of a sub-expedition, which rediscovered the grand falls, whose height was shown to be 316 feet, was briefly referred to. In closing, Prof. Lee said that, while a great many additions to the fauna have been made by the large collections secured, there is still great opportunity for further investigation and exploration, and the members of the expedition consider the country a very important field.

Studies of the Gulf Stream.

The last report presented to the meeting was by Prof. William Libbey, Jr., of Princeton University, and it proved one of the most interesting and valuable of the series. It referred to the study, with the United States Fish Commission, of the currents in the Gulf Stream on portions of the Atlantic coast. The Professor said the work was conducted on a series of lines parallel to the coast of New Jersey, between Block Island and Nantucket. Along these lines, which were 150 miles in length, were made a series of stations, at which stations observations were made in temperature and densities; also in currents; and, at the same time, meteorological observations. All of these observations, he said, showed the peculiar relations of the Gulf Stream to the Labrador current. The position of the different curves of temperature were drawn after these observations were plotted. These curves of fifty degrees showed marks of the boundary of the intrusion of the Labrador current into the northern edge of the warmer waters.

Then the fact was shown, continued Professor Libbey, that we were dealing with two different sets of currents—one a deep series, and the other a surface set; both being modified by the mechanical laws of their motion, by changes in velocity, temperature and density. But the surface currents were further modified by the direction, duration and velocity of the wind currents.

The appearance of smaller, band-like currents upon the north-bound Gulf Stream, which were reversed in the direction of their motion after they had passed somewhat to the northward, was explained and offered as a reason for the appearance of schools of fishes at different points of the coast, since the warmer waters provide the proper conditions

for the growth and distribution of the fishes' food, by the bridging over of the cold current.

The effect of the wind on the modification of the northern boundary of the Gulf Stream was pointed out, and it was shown that it had been moving towards the New Jersey coast at the rate of sixty miles per year. The pilot charts of the North Atlantic coast, in which were given the direction and velocities for the last three years, were exhibited to support this view. Further, the influence of these changes in the conditions in temperature and moisture upon our climate were pointed out and some explanations offered.

GEOLOGY AND PALEONTOLOGY.

The Earthquake in Japan.—In a recent letter to the New York *Tribune*, Mr. Kairiyama, a Japanese resident of New York, states he has received letters from Japan containing many particulars of the terrible earthquake in that country, which took place October 28. The section chiefly afflicted was the great island of Hondo, which is the main island of the Japanese empire, embracing many provinces. The surface of the ground at the time of the disturbance was terribly shaken. No person could stand. Houses were instantly thrown down; fire instantly raged, roasting the imprisoned victims. The shocks took place at intervals during four days, and varied from 100 to 600 in different localities. Relief funds are being subscribed in this and other countries.

The London *Daily Graphic* says: "Twenty-six thousand five hundred people were killed and wounded; 90,000 houses destroyed; 200,000 people homeless. Not even the distance between them and us, which robs the facts of so much of their import, the figures of so much of their meaning, can deprive them of all. There are people starving, too; and this is a tangible ill, which we may attempt to lessen as well as to appreciate. An appeal has been made by the Japanese people to our charity. The disaster which has overtaken them is not within human power to foresee or to prevent; but some of the consequences it is only human to attempt to alleviate."

The steamer China, which recently arrived at San Francisco from Hong Kong and Yokohama, reports that, while the steamer was between Hong Kong and Yokohama on the return trip to San Francisco, an imposing sight was witnessed by the passengers and crew.

The great earthquake at Yokohama had taken place a short time previous, and many of the islands in the Yellow Sea were in a state

of volcanic disturbance. About seven o'clock on the evening of Nov. 3d, the China was passing the Aleutian Islands, in Van Diemen's Straits, when, suddenly, the island of Suson seemed all ablaze, and flames and lava shot up a distance of 800 feet into the air.

The steamer was twelve miles distant, and the spectacle, as seen from her decks, was grand. The night was dark, and the eruptions from the crater of the volcano took place at intervals of about fifty seconds. They were accompanied by detonations, which, in the distance, sounded like bombs exploding, and, after each discharge of molten lava and flames, the burning fragments descended like sparks from a gigantic Roman candle.

The American bark Hesper, also lately arrived at San Francisco from Kobe, Japan, after an excellent passage of twenty-seven days, reports a graphic account of an experience with a submarine volcano, hot sea-water and sulphurous gases.

Capt. Sodergren states that, about 6.30 A. M., on October 28, while lying at anchor in Kobe, the bark received a sudden shock that caused the masts to strain and crack. Some of the standing rigging snapped like a piece of twine, and all hands were thrown from their feet. The vessel pitched heavily, and caused one of the cross-trees to break from its fastenings and fall on deck. The waters became still an hour later, and the bark put to sea.

Early on the morning of October 30, when about seventy-five miles off the Japan coast, the bark was almost thrown on her beam ends by the sudden eruption of a submarine volcano. The water became so hot that, when a sea was shipped on deck, the crew took to the rigging. The heat became so intense that the pitch in the deck was melted and the seams opened.

"Great blasts of hot air, with a strong sulphurous smell," said the captain, "would come up from the breaking surface of the ocean and almost suffocate us for the moment. Then the membrane of the nostrils became irritable, causing us all to have a fit of sneezing. This phenomenon lasted for several hours. I have had all I want of the Japan side for some time to come."

Prof. Horace Briggs, of Buffalo, who was in Japan at the time of the earthquake, says immense crevices, from which hot mud and steam escaped, were to be seen in all directions.—*Scientific American*, Dec. 19, 1891.

The Report of the Minnesota Natural History Survey for 1889,[1] an 8vo. of 234 pages, has, for its contents: Summary Statement

[1] The Geological and Natural History Survey of Minnesota. Eighteenth annual report for the year 1889. N. H. Winchell, State Geologist.

for 1889; Report of Field Observations made in 1888, in 1889, N. H. Winchell; American Opinion on the Older Rocks, A. Winchell; Additions to the Library of the Survey since 1884; List of Publications of the Survey.

This report gives an idea of the progress that is being made in the intricate geology in the northeastern part of the State, and of the economic resources that are being developed there. Mr. N. H. Winchell's field observations confirm the views set forth by Irving, Bonney and Lawson, and the conclusions published by the Minnesota Survey, to the effect that the Huronian System, as now defined and understood by the Canadian geological reports, really embraces two or three formations; that one of them is the true Huronian of Murray; another is the Kewatin of Dr. A. C. Lawson, containing the iron-ores at Tower, Minn.; and another is the series of crystalline schists which Dr. Winchell calls the Vermilion series. They are distinctly separated by lithology and unconformities that have been noted from Vermont to Minnesota, and can no longer be included under a single term.

Report of the Geological Survey of Texas, 1889.[1]—The first annual report of the Geological Survey of Texas is presented in 8vo. form of 410 pages, with maps, sections and plates. The general reports of the State geologist and the several field geologists is followed by important papers on the economic geology of the State. Mr. Penrose reports on the iron ores of Eastern Texas, which necessarily includes an account of the general geology of the Gulf Tertiary. Mr. Hill discusses the economic uses of the Cretaceous rocks. Messrs. Cummins and Tarr are studying the problems of the coal, the gypsum and the salt, which are found in the Carboniferous period, and contribute papers on these subjects. Mr. Von Streeruwitz gives a preliminary statement of the geology of Trans-Pecos Texas, with reference to mining interests, and Mr. Comstock a preliminary report on the central mineral region of Texas. Both of these papers contain valuable information concerning the older rocks of the State.

Infusorial Earths of Pacific Coast.—In a recent paper (*Am. Journ. Sci.*, Nov., 1891), Mr. A. M. Edwards has described seven new fluviatile, fossiliferous deposits from Oregon, California and Washington, four of which are from the western side of the mountains, one from the gap, and one from the east; proving that the fresh-water

[1]First Annual Report of the Geological Survey of Texas, 1889. E. T. Dumble, State Geologist.

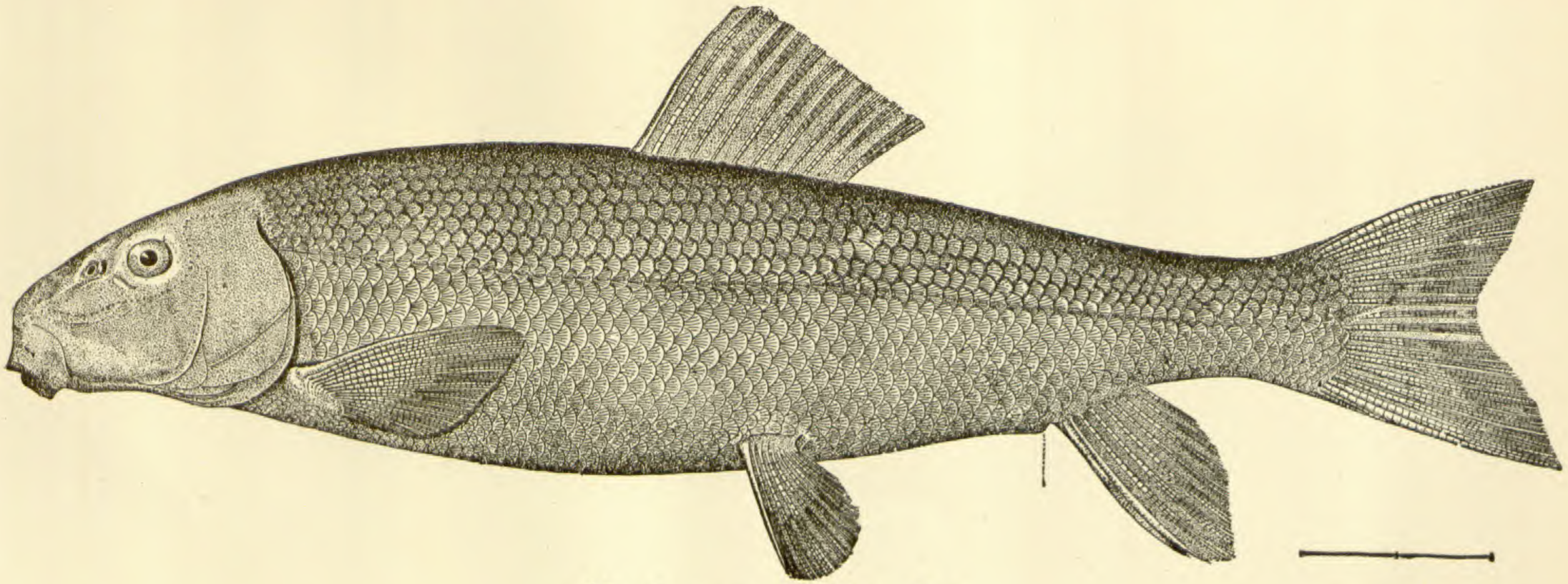
deposits are not confined to the eastern slope, as Bailey had supposed. Mr. Edwards further states that the geological age of a fresh-water Diatomaceous strata cannot be determined by means of the microscope unless they are proved by other evidence to be of greater age than the present period. Enough is known of the habitat of certain species to make it easy to tell whether the deposit has been made in pond, lake, river, marsh, bay or ocean.

On the Relationship of the Plistocene to the Pre-plistocene Formations of the Mississippi Basin South of the Limit of Glaciation.—In the *American Journal of Science*, May, 1891, is published a paper, the joint production of Mr. T. C. Chamberlin and Mr. R. D. Salisbury, on the relationship of the Loess and the Orange Sand south of the limit of glaciation. The deposits investigated by the writers are included between the parallels of 35° and that of the northern limit of the Mississippi Basin. Throughout much of this territory the loess lies upon the glacial drift. It may be traced across the limit of the drift from north to south. The continuity is complete, and the character of the formation is the same on both sides of the line which marks the limit of ice advance. North of the limit, the evidence, in the judgment of the writers, is conclusive that the loess belongs to the closing stages of the first glacial epoch. If, therefore, the age of the loess which covers the drift be first glacial, the age of that which lies south of the drift, in the area under discussion, is likewise first glacial.

Between the relationship of the till north of the limit of glaciation and the relationship of the loess to the residuary earths of the Paleozoic rocks immediately outside the drift there is an important difference. The presence of a weathered and highly-oxidized zone, subjacent to the loess, south of the drift-limit, is as conspicuous as its absence to the north. This oxidized zone is the upper surface of the residuary earths, and clearly indicates the existence of a long interval between the loess and the residuary earths beneath.

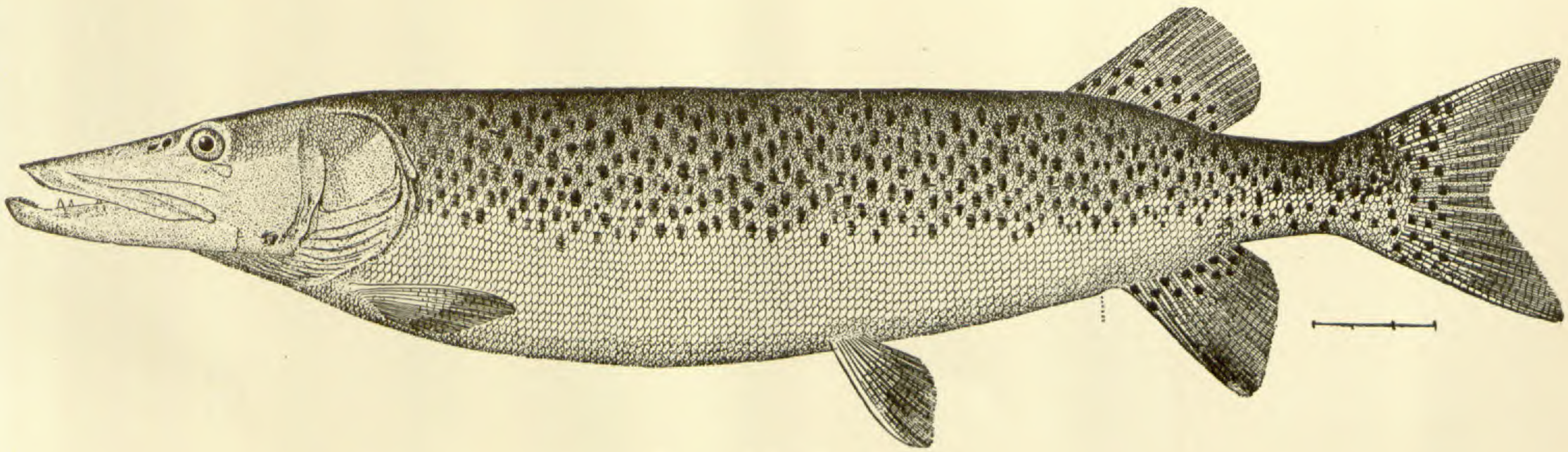
Beneath the loess, south of the limit of glaciation, lie the series of gravels and sands known as the Orange sands. It is a peculiarity of the distribution of loess, that elevations within the area of its occurrence seem to be no obstacle to its presence. The same may be said of the gravel. From their relative position it is evident that the latter is the older of the two. That it is much older is shown (1) by a zone of oxidation between the loess and the Orange sand; (2) by a marked unconformity when the loess covers a hill, indicating a long period of

PLATE II.



Myxostɔma macrolepidotum Les.

PLATE III.



Esox nobilior Thomps.

pre-loessial erosion; (3) by chemical changes in the sands and gravels, due to long exposure to atmospheric agencies.

Further evidence is adduced to show that the Orange Sands cannot be referred to the first episode of the glacial epoch, nor to the interval between the two glaciations of the first glacial epoch—they are undoubtedly pre-plistocene; and the conclusion is given as follows:

"In the light of the foregoing evidence, we find but one conclusion possible respecting the age of the Orange Sand. In six States, at least, it is true that, beneath the loess and above the Orange Sand, there is an old surface so deeply weathered and oxidized as to indicate a long period of exposure before the deposition of the loess. . . . . Everywhere below this horizon there is an absence of material which can be referred to a glacial origin; while, above this horizon, the loess and other fluvial deposits contain material of glacial derivation. *This old surface we hold to be the dividing plane between the Plistocene and the Pre-plistocene formations.*"

Cretaceous Fossils from Syria.—A bulletin of the American Museum of Natural History, issued December, 1891, contains observations on some Cretaceous Fossils from the Beyrut district of Syria, in the collection of the Museum, with descriptions of some new species by R. P. Whitfield. A tabulated list shows that, of the 175 species, 93 are Lamellibranchiates and 82 are Gastropods, from six distinct beds of Cretaceous rocks, the lowest of which is above the zone of the *Cidarites glandarius* Lang., below which comes the Jurassic beds of Mejdel el Shems.

The Age of the Staked Plain of Texas.—Mr. R. T. Hill has stated that the superficial beds of this large area (10,000 square miles) are of Cenozoic age. Mr. W. T. Cummins states (First Annual Report of the Geological Survey of Texas) that they are of light-colored calcareous material, and he calls them the Blanco Canyon beds. Dr. E. T. Dumble, director of the Geological Survey of Texas, having sent me some vertebrate fossils from Blanco Canyon, I have determined them as follows: A new species of Equus (*E. simplicidens* Cope) is associated with a Mastodon with molar teeth of the *M. angustidens* type, and a new species of land tortoise, *Testudo turgida* Cope. The association of the genus Equus with the Mastodon of the angustidens type has not been observed previously on this continent, the latter ceasing with the Loup Fork beds, and the former commencing with the Equus bed. The Blanco formation may thus be regarded as

Mo. Bot. Garden,
1893

between the two in age, and as filling a gap in the geologic series hitherto vacant.—E. D. Cope.

Boulder Trains and Boulder Belts.—Mr. T. C. Chamberlain recognizes two leading types of glacial boulders: (1) boulder trains, and (2) boulder belts. Boulder trains originate from knobs or prominences of rock which lay in the path of the glacial movement. They lie in the line of glacial movement, but not strictly parallel to it, but rather in radiating lines, and may be called boulder fans. The boulders are usually of a single kind, growing smaller and more worn as traced away from the parent knob, and are mingled with the underlying drift. The boulder belts lie transverse to the direction of glacial movement, are composed of stones of different kinds, from distant sources, and do not mingle deeply with the underlying drift. These boulder belts coincide closely with terminal moraines, which suggests that they were deposited by the margin of the ice that formed the moraines.—*Bull. Geol. Soc. Am.*, Vol. I., 1889.

Geological News.—General.—Elk Lake, discovered by Mr. Chambers, July 6, 1872, is officialy announced as the ultimate source of the Mississippi River.—*Am. Geol.*, Nov., 1891) —— According to J. C. Branner, Crowley's Ridge, in Eastern Arkansas, is not an upheaval, but is the result of an erosion along both sides of it. The ridge is capped with Tertiary, while the valleys, both east and west, are covered with material of a later date. (Report Geol. Surv. Ark., 1889.)——Mr. Ellsworth Call's studies of the geology of Eastern Arkansas have shown that divisions within this area must be based upon stratigraphic and petrographic, rather than upon paleontologic data. The paucity of fossil remains to preclude a classification based upon faunal contents. (Report Ark. Geol. Surv., 1889.)

Paleozoic.—Mr. G. F. Matthew is of the opinion that more than one horizon of life is represented in the assemblage of forms known as the Olenellus Fauna. This appears to be indicated by the fauna of Washington County, N. Y., the source of the Emmons types, which has been recently studied by Mr. Walcott. (*Am. Geol.*, Nov., 1891. ——A series of papers on the Paleontology of the Ohio Valley, by J. F. James, is being published in the *Journal of the Cin. Soc. Nat. Hist.*, 1891. The first one treats of Plantæ and Protozoa. The other groups will be taken up in regular order.——A study of the rocks at Point Pleasant, in Southern Ohio, leads Mr. James to the conclusion that there is no more reason for assigning them to the Trenton than there

would be in making a similar disposition of the lowest beds at Cincinnati. This is contrary to opinions hitherto held, as they have been generally referred to the Trenton. Mr. James considers them part of the series known as the Cincinnati group of Meek and Worthen, for which Walcott has proposed the name Cincinnati Shale and Limestone in the Hudson Terrane. Mr. James remarks, in this connection, that there is no good reason to say that the Trenton outcrops at the surface in any locality within the borders of Ohio. (*Journ. Cin. Soc. Nat. Hist.*, July, 1891.)

Mesozoic.—M. Philippe Thomas reports valuable deposits of phosphate of lime in the cretaceous marls of Tunis. The most important are located in the southwestern part of the high plateaus. (*Rev. Sci.*, Nov., 1891.)——The left ramus of a mandible of *Homoeosaurus major* was exhibited by Mr. Boulenger at a recent meeting of the London Zool. Soc. The specimen was taken from the Forest Marble in Wiltshire. (Proceed. London Zool. Soc., Feb., 1891.)——A recent paper by Mr. Lydekker, on *Ichthyosaurus tenuirostris* concludes as follows:

"It appears from the recent researches of Dr. E. Fraas that the type of *I. acutirostris* Owen has smooth, carinated teeth like those of *I. platydon*, so that this species should be transferred to the Platyodont group, which it has been proposed to raise to generic rank as Temnodontosaurus. This leaves the name *I. quadriscissus* as the one best applicable to the other specimens catalogued as *I. acutirostris*. Moreover, Dr. Fraas considers that *I. zetlandicus* Seeley is identical with quadriscissus; and we are disposed to doubt the right of separating *I. longirostris* Jäger (non Owen) from the same. Finally, we observe with satisfaction that Dr. Fraas is disposed to consider the American *Baptanodon* as inseparable from *Opthalmosaurus* of the English Oxford and Kimmeridge Clays, of which such a fine series has been recently acquired by the British museum." (Geol. Mag., July, 1891.)

Cenozoic.—Mr. Crawford has collected a series of facts which indicate that at least two or three mountain ranges in Nicaragua were deeply covered by ice during a glacial epoch contemporaneous with that which existed in the North American continent. (Am. Geol. Nov., 1891.)—According to R. E. Call the silicified woods of Eastern Arkansas are all of Tertiary age. They are silicified lignite, derived from the beds of Eocene clays that underlie the sands and gravels in which they commonly occur. (Am. Jour. Sci., Nov., 1891.) T. M. Boulanger has described a new extinct turtle (*Testudo microtympanum*),

probably from Mauritius. Its principal distinctive features are the very small tympanic cavity and the backward prolongation of the palatines and vomers, the latter forming a suture with the basisphenoid. (Proceeds. Lond. Zool. Soc., Jan., 1891.)——Two species of Procoptodon are described and figured by Mr. Lydekker in the Quarterly Journal of the Geological Society, Nov., 1891. These fossils are two mandibular rami, and they were obtained from the claybeds near Miall Creek, on the Northern frontier of New South Wales. They have been referred provisionally to *P. rapha* and *P. goliah*.

MINERALOGY AND PETROGRAPHY.[1]

Petrographical News.—The eruptive rocks of Velay, Haute Loire, France, in the order of their age are basalts, trachytes and trachytic phonolites, augite andesites, porphyritic basalts, nepheline phonolites and nepheline basalts. Termier,[2] who describes them, gives but a few brief notes on each type. The younger phonolites form the larger part of the hill. They contain aegerine in light-green porphyritic crystals, and in microlites. At the south-east of St. Pierre-Eynac are tertiary clay slates cut by dykes of phonolite, whose tiny veins penetrate metamorphosed phases of the clastics, and are thus consequently regarded as the agents producing the alteration. The rocks representing the first stage in the alteration consist of granitic debris, in which secondary opal has been deposited around the feldspar and quartz fragments. In some instances, in addition to the opal there have been formed also secondary quartz and calcite, the former as a fibrous rim around the grains. In more intensely changed phases, the slate is traversed by veins of phonolite, whose contact with the sedimentary rock is not visible, since on both sides of it the material of the phonolite has thoroughly impregnated the slate. On the other hand the phonolite of the veins contains sphene, but no augite, while the normal rock contains an abundance of aegerine, but no sphene. In the final stage all the quartz of the slate has disappeared, and the rock is comprised principally of opal, serpentine and clay (halloysite?), with pleonaste, colorless augite and hornblende as new products. The alteration is thus a silicification. In other, more rare cases, it is a feldspathization.—Hutchings[3] has recently studied the material of which slates are formed, having examined for this purpose, clays and micaceous sand-

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2] Bull. d. Serv. d. l. carte Geol. d. Fr. No. 13, 1890.

[3] Geological Magazine VII, 1890, p. 264 and 316, and Ib. 1891, p. 164.

stones from near Seaton, England, north of Newcastle-on-Tyne. The harder shale layers are composed mainly of mica, quartz, feldspar, zircon and other accessory minerals, as garnet, rutile, anatase, tourmaline, sphene and barite. The biotite is the first of these to undergo change under the influence of weathering processes. In the case studied it has not changed to chlorite, but has become bleached and has yielded epidote. The quartz and feldspar are uniformly distributed throughout the mass, while the mica usually lies out its flat surfaces in the bedding planes. In addition to the mineral grains already mentioned there is present a sort of groundmass or paste, made up of indistinctly granular matter, with microlites of various kinds and a large amount of a fine micaceous substance, besides large plates of a secondary mica. In a fine grained portion of the deposit, the paste is quite abundant and in it are numbers of minute rutile needles, flakes of ilmenite, some small perfect crystals of tourmaline and a considerable quantity of the secondary mica (muscovite), which differs from the clastic mica in that the edges of the grains extend out between the surrounding minerals, and the plates are full of minute rutile needles. In the very finest grained, smoothest clay bands of the region, the paste forms the largest part of the mass, while the well marked clastic grains are few in number, the biotite having disappeared entirely. Kaolin was not certainly recognized in even the thinnest sections of fire-clay, the fine grained granular substance of which this clay principally consists, being mainly the paste described above. The abundance of rutile, that is so noticeable a feature of the clays examined, is supposed to have originated upon the decomposition of the biotites, and the muscovite (or sericite), by the alteration of the paste. This mineral gradually increases in quantity, and then under the influence of pressure is so orientated that a micaceous slate results. The absence of biotite from most slates is thought to be due to the easy decomposability of the substance; and its presence in the sediments from which some slates were formed is thought to be indicated by the large percentage of rutile and epidote in the latter. In his second contribution to the subject the author describes the results of a separation of the components of a fine clay by fractional levigation, and an examination of the separated portions. He concludes from his study that nearly all the muscovite of slates, and all of the rutile bearing variety, is a secondary product, subsequent in origin to the deposition of the material from which the slates were formed.—The iron ores of Sao Paulo, Brazil, are found in two principal districts, the Jacupiranga and the Ipamena. In the first locality the ore, with a violet titaniferous pyroxene, forms a schistose rock, in which perofskite, apatite and a

zeolitized silicate are accessory constituents. As the amount of the ore increases, that of the other constituents decreases, until in some cases an almost pure magnetite results. By weathering the augite gives rise to mica in abundance. In some cases the pyroxene rock is found associated with layers in which magnetite and nepheline are the principal components. This Derby[1] believes to be genetically connected with the ore-bearing rocks, which he calls jacupirangite, and regards as eruptive. Much of the ore of the Ipanema district originally occured with acmite and apatite as segregations in an acmite syenite, which is now highly decomposed, so that the segregations are scattered like boulders over the ground. Fouque[2] has redetermined the minerals of the Santorin rocks and has discovered that his former determinations of some of them were erroneous. In the pumice of Acrotri, Isle of Thera, composed of glass fibres with opal material between, are little transparent crystals whose nature has heretofore been in doubt. A new examination proves them to be alunite. A quantity—separated and analyzed—gave: SO_3=38%, Al_2O_3=37.3%; H_2O=13.3; alkalies=11.4%. The blocks enclosed in the lava of 1866, formerly supposed to consist of wollastinite, *fassiate* and melanite, are now known to contain in addition to these substances anhydrite. The interiors of the nodules are composed almost exclusively of anhydrite, with a little augite and other constituents of the enclosing rock, in which are wollastonite and melanite. —Four small boulders of nephrite from British Columbia have been examined by Harrington.[3] Three were found near Lytton on the Fraser River, and the fourth in the upper part of the Lewes River, near the Alaskan boundary line. The composition of each is as follows:

	SiO_2	AlO_2	FeO	MnO	CaO	MgO	Loss	Sp. Gr.
1.	55.32	2.42	5.35	.52	14.00	20.16	2.16	3.0278
2.	56.98	.18	4.59	.17	12.99	22.38	2.64	3.003
3.	56.54	.40	3.61	.16	13.64	22.77	2.92	3.01
4.	56.96	.51	3.81	.53	13.29	22.41	2.91	3.007

No. 3 contains pale hornblende crystals extinguishing at 8°-18°. —Derby[4] has discovered that xenotime is an almost universal constituent of muscovite granites, and presumably of other acid potash rocks. Residues obtained by washing the powder of such rocks in a gold washer's pan nearly always yields xenotime and monazite. Eighty-six and two-thirds percentage of the undoubted muscovite granites from

[1] Amer. Jour. Sci., Apr. 1891, p. 311.
[2] Bull. Soc. Franc. d Min., 1890, XIII, p. 245.
[3] Trans. Roy. Soc. Can. 1890, p. 61.
[4] Amer. Jour. Sci., Apr., 1891, p. 308.

Brazil, examined by Derby, disclosed the presence of this accessory, which is thought by him to be as constant a constituent of these rocks as any mineral save zircon. Experiments made with granites from the United States seem to indicate the value of the pan as a petrographical instrument in the study of the rare and heavy components of rocks. —The rare blue hornblende riebeckite is reported by Cole[1] in three pebbles found in the drift of North England and of Wales, in addition to its occurrences in the microgranite of Mynydd Mawr, where it was discovered by Harker and Bonney a few years ago.

Mineralogical News.—General.—Since many of the supposed paramorphs have been proven within recent years to be due not to the molecular rearrangement of material already existing, but rather to the solution of some original substance and its replacement by a new deposition, Bauer[2] has re-examined the pseudomorphs of *rutile* after *brookite* from Magnet Cove, Ark., to determine whether or not the substance is a true paramorph. After studying many thin sections of the brookite, rutile, and intergrowths of the two, he concludes that the latter are true paramorphs, the rutile originating in a molecular re-arrangement of the TiO_2. The rutile begins to form on the exterior of the brookite crystals, or along cracks in them, as needles penetrating the brookite substance. The rutile pseudomorphs after anatase from Brazil, the Urals and other[3] localities, are also declared to be true paramorphs. The same author has also re-examined the *Michel-levyite* of Lacroix, which. Dana declared to be barite, and finds that Dana's statement is correct The axial angle is large, but it cannot be measured, as the acute bisectrix does not enter the field of view. The mineral differs from ordinary barite only in the possession of a very perfect cleavage in the direction of one prismatic face. On the base it shows twinning striations resembling those of plagioclase. The twinning plane is the prismatic face parallel to which is the most perfect cleavage. The structural peculiarities of the Perkin's Mill barite are all due to this abnormal cleavage, which in turn is dependent upon the twinning, which is new to the mineral, and is probably the result of pressure. Measurements of druse crystals of the same substance yield the forms characteristic of barite and the new plane $\frac{1}{12}\,P\breve{\infty}$ with $a:b:c = .8152:1:1.3136$.—The mineral associated with calcite and phillipsite as druses on the leucite,

[1] Miner. Magazine, IX, 1891, p. 222.
[2] Neues. Jahrb. f. Min., etc., 1891, I, p. 217.
[3] Ib. p. 250.

tephrite of Eulenberg in Bohemia, pronounced by Zepharovich[1] to be orthoclase, has been carefully investigated by Gränzer,[2] who thinks it more likely to be a *zeolite*. Its crystalization is probably triclinic, though by the parallel growth of many individuals there is built up a form closely resembling that of orthoclase.—The minerals characterizing the hollow spherulites of the rhyolite of Glade Creek,[3] Wyoming, and of Obsidian Cliff, in the Yellowstone National Park, like those found in other lithophysæ, are thought to be the results of aqueo-igneous fusion upon the material of the acid lava. The most abundant mineral thus formed is *quartz*, whose crystals are either attached to the walls of the cavities, thus exposing only one termination, or are interlaced forming a network built up of crystals occasionally doubly-terminated. Both the rare $+\frac{3}{2}$ R and $-\frac{3}{2}$ R are well developed, and also the equally rare forms $\pm\frac{3}{2}$ $P\frac{3}{2}$. The next most noticeable mineral is *fayalite*, whose habit has already[4] been described. In some of the more irregular cavities at Glade Creek are accumulations of very small *sanidine* crystals, *hornblende* and *biotite*, of which the latter is never found associated with fayalite.—The *rhodizite* from the Urals, which has been declared to be regular with ∞ O and O_2, is pyroelectric. The examination of it, extinction and its interference colors shows it to be pseudosymmetrical it being in reality monoclinic[5] with $a : b : c = .707 : 1 : 1$. $\beta = 90°$. The dodecahedron becomes OP,—P, +P and $\infty P\infty$ and the tetrahedron $\pm O_2 P_{\overline{\infty}}$ and ∞ P 2. An interesting series of experiments made by the same mineralogist on *jeremejewite* lately described by Websky[6] shows it to consist of an interior hexagonal kernel, surrounded by two zones with some orthorhombic properties, and an external one, with the characteristics of the kernel. The density of the material in each zone is the same, and its reaction under pressure and temperature is similarly slight. The kernel and the peripheral zones are uniaxial and negative, while the other two zones are biaxial, the inner one possessing the larger optical angle. The explanation of the phenomena offered by the author is to the effect that in the first stage of the mineral's growth it separated as an orthorhombic substance on the walls of the cavity. Upon this were deposited zones two and three, after which the cavity was filled by what is now the kernel. The optical anomalies of *phacolite*

[1]Sit. d. Kais. Ak. d. Wiss., 1885, X, p. 601.
[2]Min. u. Petrog. Mitth. XI, 1890, p. 277.
[3]Iddings & Penfield: Amer. Jour. Sci., July 1891, p. 39.
[4]Ib. XXX, July 1885, p. 59, and Ib. p. 271.
[5]Klein. Neues. Jahrb. f. Min., etc., 1891, I. p. 77.
[6]Ib. 1884, I, p. 1.

and *chabazite* are ascribed to the same causes as those assigned to the anomalies of analcite.—Some doubt having been cast upon the correctness of Baumhauer's conclusion that *nepheline* is trapezohedrally heni-hedral, the mineral from three bombs of Vesuvius has again been examined. The figures produced on the ∞ P faces of crystals, upon etching with HCl and H F, are unsymmetrical; consequently their crystalization is either pyramidal or trapezohedral hemihedral, and the forms are hemimorphic with respect to the vertical axis.[1]—Saltman[2] records the following as the composition of a *melanite* from Oberrothwell in the Kaiserstuhl:

SiO_2	TiO_2	ZrO_2	Al_2O_3	Fe_2O_3	Mn_2O_3	FeO	CaO	MgO	Na_2O	K_2O	Loss
30.48	11.01	1.28	3.13	15.21	.28	3.84	30.19	2.28		1.65	.19

It is interesting for the large percentage of titanium shown by it, and for the considerable quantity of zirconium, which has heretofore never been found in any member of the garnet group.—After examining critically more than fifty analyses of *vesuvianite*, Kenngott[3] concludes that the composition of the mineral must be represented by a formula of two parts, like that of apatite. The silicate portion may be represented by $4\ (2\ RO.\ SiO_2) + 2\ R_2O_3,\ 3\ SiO_2$ [$=4\ R''_2\ SiO_4 + R'''_4\ (SiO_4)_3$]. The composition of the non silicated portion is not yet known, but it probably contains the hydroxide group, sodium, potassium, and sometimes fluorine, in varying proportions.—*Almogen*[4] crystals from the Pic-de-Teyde, Teneriff are tabular in habit. They are negative and crystalize monoclinically with $a : e = 1 : .825$. $\beta = 97°34'$.—Rose colored dodecahedral garnets from Xalostic, Mex., have been analyzed by De Landero.[5] Their density is 3.516 and hardness 7.5. Their composition corresponding to $(Ca\ Mg)_3\ Al\ Fe)_2\ (SiO_4)_3$, is:

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	MnOBaO	Res.
40.64	21.48	1.57	35.38	.75	tr.	.17

—Some good sections of *pericline* from the Pfitschthal, Tyrole, have been very carefully studied by Münzig.[6] Their optical properties indicate that the substance is not a pure albite, but that it is an intergrowth of oligoclase (ab-an) with albite. The former comprehends the larger part of the pericline crystals, the latter appearing in it as small irregular flecks. Both feldspars are twinned according to the pericline law, with the albite apparently occupying pores in the oligoclase.—Des

[1]Baumhauer: Zeits. f. Kryst. XVIII, p. 611.
[2]Ib. p. 628.
[3]Neues. Jahrb. f. Min., etc., 1891, I, p. 200.
[4]Becke: Min. u. Petrog. Mitth., XII, p. 45.
[5]Amer. Jour. Sci., 141, 1891, p. 321.
[6]Neues. Jahrb. f. Min., etc., 1891, II, p. 1.

Cloizeaux[1] notes the similarity in habit between *chalcopyrite* crystals from Cuba and those of the French Creek Mines in Chester Co.,[2] Pa. A comparison of recent analyses of *violan* and *anthochroite* leads Igelström[3] to the conclusion that the two are identical.—In a recent brochure of the American Geological Society, Kunz[4] announces the discovery of small *diamonds* in the alluvial sands of Plum Creek, Pearce, Co., Wis., and the occurrence of fire opal in a vesicular basalt at Whelan, Washington.—Sandberger[5] has found pseudomorphs of markasite after pyrargyrite at Chanarcillo, Chile.

Miscellaneous.—Syntheses.—Lorenz[6] has produced crystallized zinc sulphide by the sublimation of the amorphous salt in an atmosphere of ammonium chloride. The action is explained as taking place in two stages—first, the formation of zinc chloride and its sublimation, and secondly, the action of sulphuretted hydrogen upon this salt. By the action of dry H_2S on the respective metals crystalized *troilite, millerite, wurtzite* and *greenockite* were formed. The first is in little opaque tabular crystals, that are at first silver white and afterwards bronzy-yellow in color. According to Prof. Groth, they are probably hemimorphic. In addition to the greenockite there were produced in the same operation other crystals that are seemingly cadmium sulphide.—Though the synthetical production of augite is not a difficult problem, that of hornblende has heretofore resisted the best efforts of mineralogists to effect it. Chrustschoff[7] has however lately succeeded in obtaining the mineral by heating in a glass tube, from which the air had been extracted, a mixture of dialysed colloidal silicic acid containing 3% of SiO_2, and dialysed solutions of Al_2O_3, $Fe(OH)_3$ and $Fe(OH)_2$, with lime water, freshly prepared $Mg(OH)_2$ suspended in water, and a few drops of sodium and potassium hydroxides. Upon heating these together for about three months at 550° the mixture became of a dirty-brownish-green color, when it was found to contain tiny hard grains of hornblende, analcite quartz, feldspar and diopside. The hornblende crystals were bounded by $\infty P\bar{\infty}$, $P\bar{\infty}$ and ∞P. Their extinction $c \wedge C = 17°50'$. Their

[1]Bull. Soc. Franc. d. Min., XIII, p. 335.
[2]Cf. American Naturalist, 1889, p. 528.
[3]Neues. Jahrb. f. Min., etc., 1890, II, p. 271.
[4]Bull. Geol. Soc. Amer., Vol. 2, p. 638.
[5]Neues. Jahrb. f. Min., etc., 1891, I, p. 199.
[6]Ber. d. Deutsch. Chem. Ges. No. 9, 1891, p. 1501.
[7]Neues. Jahrb. f. Min., etc., 1891, II, p. 86.

double refraction was negative and pleochroism strong. $2V=82°$, and composition :

SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	Na_2O	K_2O	Loss
42.35	8.11	7.91	10.11	14.33	13.21	2.18	1.87	.91

—Otto and Kloos[1] find perfect crystals of periclase on a muffel in which magnesium oxychloride has been heated.

General.—The solubility of quite a number of minerals in pure water and in dilute salts has been carefully investigated by Doelter.[2] The sulphides, sulpho-salts, oxides and silicates examined are slightly soluble in water, with the addition of sodium sulphide the solubility of the first two groups is increased while that of the oxides is increased by sodium fluoride. The carbonate of sodium appears to produce but little effect upon these. The silicates are more readily soluble in carbonated water and in dilute solutions of sodium carbonate. Distilled water seems to act simply as a solvent upon all classes, whereas the other reagents produce more or less decomposition. Gold is dissolved to some extent in both the silicate and the carbonate of sodium at high temperatures. —Two instruments for the observation of the optical properties of minerals at high temperatures are described by Klein,[3] and a third by Fuess.[4] One is adapted for use on the microscope, where temperatures not greater than 450° are required. The second allows of observations at a bright red heat, the source of heat being electrical. The third is for use with gas.—Miers[5] gives a description of a simple and cheap, though quite accurate goniometer for student's use. Rinne[6] outlines an easy method of determining the character of the double refraction in uniaxial and biaxial crystals in converged light, based on the use of the gypsum plate. Practically the determination depends largely upon the colors of different segments of the microscopic field. It is especially valuable in determining the sign of weakly doubly refracting substances.—The fifth part of Hintz's Handbuch der Mineralogie[7] concludes the treatment of the mica group, and deals in the usual thorough manner with the chlorite and serpentine groups.

[1]Ber. d. Deutsch. Chem. Gesell, 1891, p. 1488.
[2]Min. u. Petrog. Mitth. XI, 1890, p. 319.
[3]Neues. Jahrb. f. Min., etc., 1890, I, p. 65.
[4]Ib. B. B., VII, p. 406.
[5]Min. Magazine, IX, 43, p. 214.
[6]Neues. Jahrb. f. Min., etc., 1891, I, p. 21.
[7]Leipzig 1891, p. 641-800.

BOTANY.

Notes on The Flora of Western South Dakota.—The following paper was read before the Botanical Seminary of the University of Nebraska by Professor T. A. Williams, of Brookings, S. D.

The region west of the Missouri River may be divided into three quite distinct botanical districts. The Range, The Black Hills, and The Badlands. The first is much the largest, extending from the River on the North and East to The Badlands on the South and the Black Hills on the West. It is a broad stretch of prairie varying from level tableland to rolling prairie or in many places becoming quite rough and broken, especially along the streams which traverse the region at varying intervals. The second region comprises the highlands, cañons and mountains of the Black Hills country. The Badland region begins near the Mouth of Indian Creek on the Cheyenne River and extends southward skirting the Hills, reaching into Nebraska. The strip of country varies from ten to about thirty miles wide. The surface is very broken and the soil dry and sterile, excepting in some of the basins where a little poor water is found giving life to *some* vegetation.

My visit to these regions was made in August of the past year (1891). Not a very good time for collecting so far as the number of specimens is concerned, but nevertheless a time when one can form a fair idea of what the characteristic plants of the regions are.

I shall not soon forget the impressions I received when, as we climbed the bluffs out of the narrow valley of the River at Ft. Pierre, the wide stretch of miles upon miles of dry prairie came to view. As far as the eye could reach nothing could be seen but that peculiar monotonous color of grass dried prematurely. Not a very inviting outlook for a botanist. Along the bluffs of the River we had made several finds and were beginning to hope that we should have a profitable trip, but at the sight of that dreary waste of sunburnt prairie our hopes fell. However our fears proved to be groundless, for as we soon learned things are not always "what they seem." The creeks, which occur here and there throughout the range, are veritable mines for the botanist. Very few of them contain running water at this time of the year. Usually they are nothing more than a chain of ponds, containing from a few inches to a few feet of water. These streams are a continual source of delight to the collector. They are usually separated a con-

siderable distance by a stretch of dry prairie which forms a very effective barrier to an interchange of species, consequently each stream has a few plants that seem to be peculiar to its own territory, and the collector is continually running across new things. There are a few of the larger ponds that do not contain one or more species of *Chara*, *Potamogeton*, or some other of the water loving plants. *Potamogeton hillii*, *P. pectinatus*, and *P. zosteræfolius*, were common. *P. fluitans* was found at Mitchell's Holes, but at no other place; *Sagittaria variabilis* occurred in some of its various varieties throughout the entire region; *Atriptex argentea*, *Xanthium canadense*, *Solanum rostratum*, *Euphorbia marginata*, *Helianthus annuus* and *H. petiolaris* were common all along the trail from Pierre to Rapid City. At Ft. Pierre, Peno Hills, and Willow Springs *Amorpha microphylla* was common along with *A. fruticosa* and *A. canescens*. Our old friend *Saponaria vaccaria* was found at intervals along the entire way to the Black Hills, a good example of man's influence in the introduction and distribution of plants. Does not this give a hint as to how eastern species advance westward? I have noticed similar instances along the old freighting trail in Nebraska, which runs from Nebraska City to Denver. The principal grasses of the range are, *Boutelova oligastachya*, *B. hirsuta* and more rarely *B. racemosa*, *Buchloe dactyloides*, (fast disappearing), *Agropyrum glaucum*, several species of *Calamagrostis*, and *Stipa comata*, the last species replacing the common *S. spartea* of the eastern part of the State. *Agropyrum glaucum* forms by far the greater part of winter as well as the summer feed of the stock of the range.

Spartina cynosuroides, several species of *Glyceria*, *Carex*, and *Scirpus* grow along the streams and form no small part of the food of the stock during the drier seasons of the year.

Oxytropus lambertii was common, many species of *Astragalus* were found in fruit but few in bloom. Plums and cherries were of frequent occurrance along the larger streams. One stream in particular has its banks lined with plum bushes for miles and miles and is called Plum Creek. Many people go thirty or forty miles to get the plums, many of which are very large and toothsome; *Shepherdia argentea* in both red and yellow-fruited forms occurs from the Missouri River to the Black Hills. The fruit of some of the trees of this species is quite palatable. Not far from Plum Creek on a hillside I found *Shrankia uncinata*. The whole hillside was a mass of this plant and I procured some of the finest specimens of it that I have ever seen. While we were camped at Grindstone Buttes I collected my first specimens of *Marsilia vestita*. It grew along the margin of a small pond;

many specimens were found where both of the so-called varieties of this species grew on *one stem,* one part of which grew on the bank and the other in the water. I thought I had made a great find but as I learned later this little plant is very common from the Buttes to the Black Hills, hardly a pond being free from it.

On the summits of the Buttes we found *Dalea aurea* in considerable quantity but nowhere else did it occur.

At Peno Hills, about 70 miles East of the Black Hills we found many old friends and many new ones. Along the stream which rises in these hills were good sized trees of elm, boxelder, ash, (*Fraxinus viridis* and *F. pubescens*), hackberry, willow and the like. Here we also found *Amelanchier alnifolia, Crataegus coccinea, Prunus virginiana P. americana* and *P. pumila.* The fruit of both of the cherries was very fine, while *some* small bushes of sand-cherry were found bearing fruit as large and luscious as that of the ordinary cultivated cherries. On the North slope of one of the hills *Juniperus sabina* var *procumbens* formed dense mats, especially along the small draws that lead down from the hillside. The only willows collected in this region were *Salix longifolia* and *S. cordata* var. *vestita* though I am certain that *S. amygdaloides* will be found also.

There are quite a number of small streams between Pierre and the Cheyenne River that would be as well wooded as is this stream at Peno Hills if they could be protected from prairie fires. We saw many fine groves of elm, ash, boxelder and cottonwood that had been killed by fires after the trees had grown to be two and three feet in diameter. The groves at Peno Hills are protected from the fires by means of the line of dry barren hills along the North and West and have become the pride of the whole region.

At the Cheyenne River we found some interesting things; coming down from the high uplands to the so-called second bottom we found *Psoralea tenuiflora* in abundance, for the first time. It reaches its finest development here, being much larger than I have ever seen it elsewhere. On the bluffs that border the narrow valley grew *Ipomoea leptophylla,* several *Oenotheras, Mentzelia ornata M. nuda, Musenium tenuifolium, Stanleya pinnata* and *Lupinus pusillus* (almost always accompanied by a fungus, probably a Phoma, which was very injurious to it.)

Along the cañons near Smithville the silvery form of the red cedar was quite abundant, offering a marked contrast to the common form. The buffalo berry, in both forms was plentiful everywhere. *Astralagus bisulcatus* and its near relative *A. haydenianus* grew on some of the

bluffs, on the west side of the river. The former was also found on the range and in the Badlands.

On the bottoms, which are very sandy, we found *Astragalus latiflorus* and *A. kentrophyta* in abundance. Also *Dalea alopecuroides, D. laxiflora, Croton texensis, Artemisia canadensis, A. filifolia, Stipa comata, Oryzopsis cuspidatus, Munroa squarrosa, Euphorbia petaloidia* and *E. hexagona.* The principal timber tree of the bottom is *Populus monilifera* while *Shepherdia* makes most of the thickest growth. Elm, ash, boxelder, willow, and hackberry tree occurred, but seldom in any great quantities at this place.

Farther up the river these are more abundant. The cottonwood always predominates however. The trees of this species are seldom so high as those seen in Eastern Dakota or Nebraska, but are of a much more close or bushy growth, due doubtless to the fact that the winds often break out the tops, thus producing more branches.

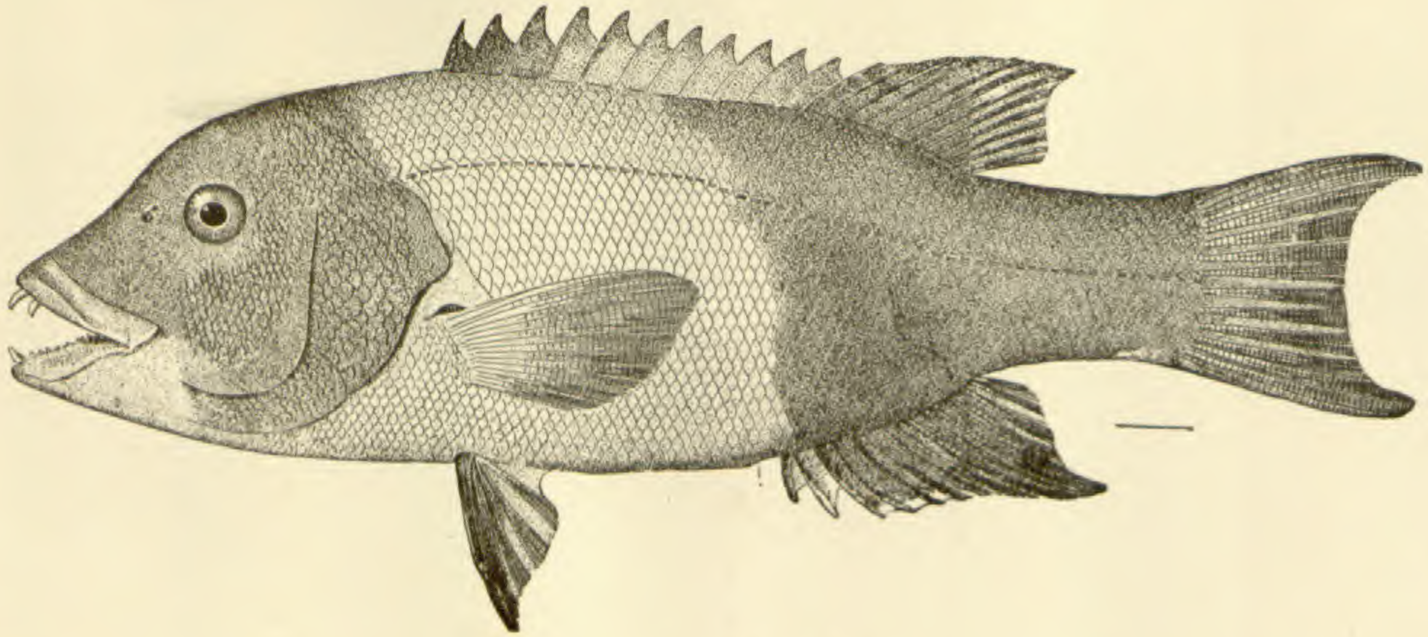
(*Concluded in February Number.*)

ZOOLOGY.

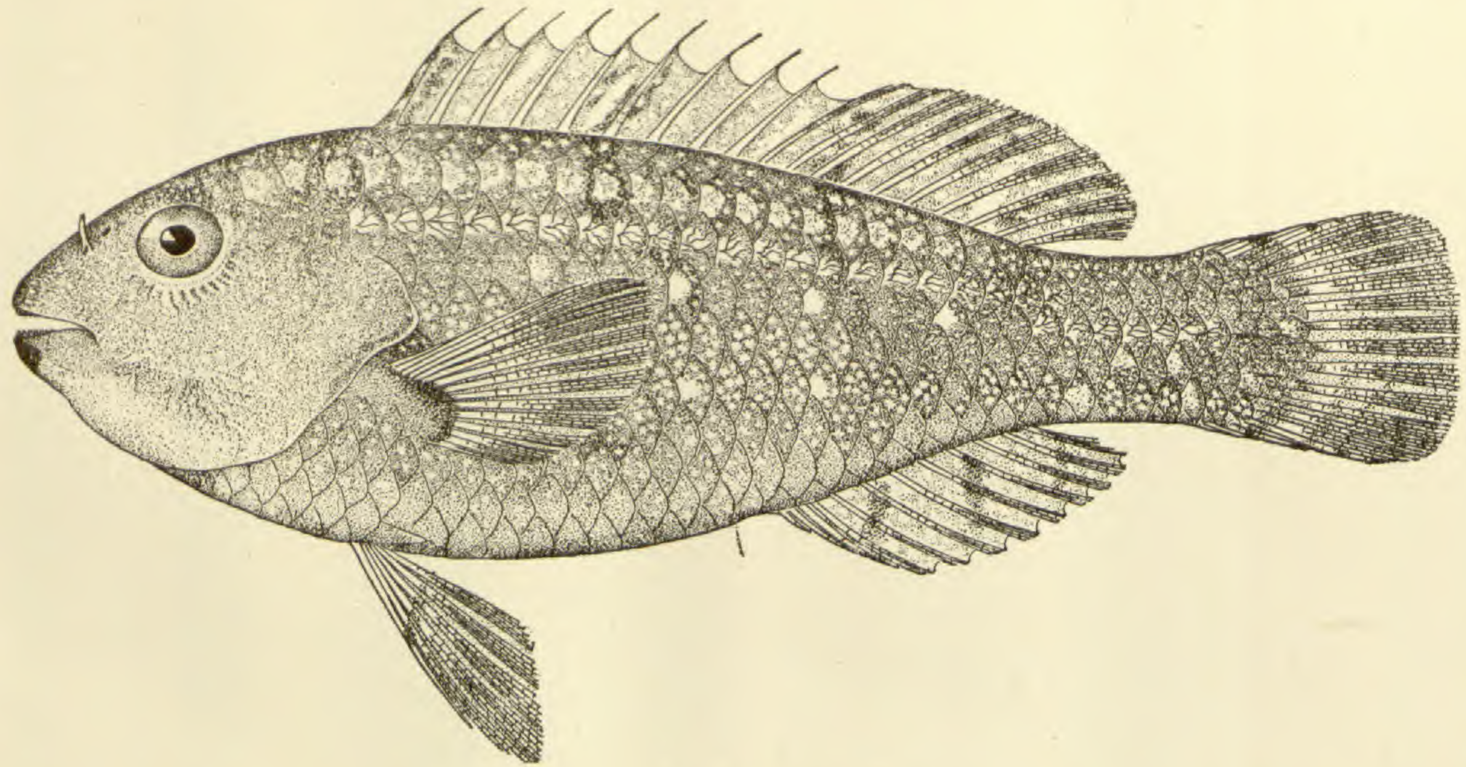
Protozoa.—A number of articles appear every month on the subject of the malaria parasites, treating of their morphology, system and pathogenity. Without going into details of all the original publications, the following may be taken as the most prominent views in regard to the parasites. Laveran, the original discoverer of the parasite which causes malaria, holds fast to the idea that only a single species of Protozoa is concerned in the disease and that the various forms, amoeba, crescent, etc., are only different stages in the development of this parasite (Du Paludisme et de son Hématozoaire, Paris, 280 p. 6 Plates, 1891). Grassi and Feletti on the other hand admit two genera: *Halmamoeba* and *Laverania*, the former with three species: *H. præcox*, producing quotidian fever, *H. vivax*, producing simple or double tertiana and *H. malaria* producing simple, double or triple quartana; Lavarania (the crescent) produces an irregular fever, (Centralblatt f. Bakt. u. Parasitenkunde IX, p. 430, 1891). *Halmamoeba* is supposed to correspond to *Amoeba guttata* and *Laverania* to *A. radiata*. Thus the malaria parasites are classified as Rhizopods by these authors. Metschnikoff, L. Pfeiffer and others class them as *Coccidia*, while Kruse argues that they must belong to the Gregarina, because an adult form is found free in the blood. In comparative Hæmo-parasitology Celli and Sanfelici (Ueber die Parasiten des rothen Blutkörperchen im Menschen und in Thieren, Fortschritte der Medicin Bd. 9, 1891) draw the conclusion that the endoglobular parasitism is more obligatory—and hence more highly developed in the Hæmogregarina of birds than in the blood parasites of cold blooded animals, since in the latter, the parasites thrive in the serum about as well as in the blood corpuscle. According to these authors, the blood parasites of the frog, on arriving at a certain stage, either undergo sporulation, or develop into *Drepanidium* of Ray Lankester.

R. Pfeiffer (L. Pfeiffer, Ueber die Pathogene Protozoen) has recently made a very important discovery in regard to the development of *Coccidium*. According to these authors, gymnospores can be developed in the growing Coccidium and serve to spread the infection to other cells. Kruse has come to the same conclusion, but independently from Pfeiffer. Kruse states the gymnospores can be formed at any time during the development of the parasite. These naked spores evidently cannot spread the infection to other animals, this work being left to the other spores (Dauersporen) which are already well-known.

PLATE IV.



Trochocopus pulcher Ayres.



Scarus hoplomystax Cope

Several authors claim to have found Microsporidia in Vertebrates; not denying their statements as a whole, the reviewer will simply state, that the portion of turtle's flesh given him for comparison, and supposed to be part of Danilewsky's original material, contained no Microsporidia, but was full of minute air bubbles between the muscle-fibres. It seems hardly possible, however, that Danilewsky and L. Pfeiffer could have mistaken these air bubbles for parasites, yet neither Railliet, Balbiani or the reviewer could find any Microsporidia. The material came from L. Pfeiffer.—C. W. Stiles.

Trematodes.—Hassall (American Veterinary Review, July 1891) describes the large liver-fluke found in American cattle as *Fasciola carnosa;* as this name is preoccupied he changes the name (Am. Vet. Rew. Sept.) to *F. americana.* [As yet it is impossible to say much in regard to this species. The animal is *undoubtedly* specifically different from *D. hepaticum,* but as I have stated in my Animal Report for 1891, bears very great resemblance to Bassi's *Distomum magnum.* Dr. Hassall and I are at present at work upon this species and hope soon to publish a full account of its anatomy and development.—C. W. S.]

Cestodes.—Dr. V. A. Moore recently presented a case of Echinococcus hydatid in a pig, before the Biological Society of Washington, D. C., and in the discussion which followed, Stiles spoke of two more unpublished cases in animals and one in man. Van Cott, of Brooklyn, has recently given a full account of this last case. It is high time, that the Health authorities in the various cities insist upon burning every organ infected with this hydatid, found in the slaughter-houses, and that more care is used in importing dogs (the final host of this tape worm,) from infected regions, if we wish to avoid an experience such as Australia has had for the past quarter of a century.

Prof. Linton has recently published several valuable papers on the parasites of fish (Notes on the Entozoa of Marine Fishes of New England, I and II; a contribution to the Life History of Dibothrium cordiceps; on two species of larval Dibothria from the Yellowstone Park; all published by the U. S. Fish Commission and free to scientists). These papers will be found to be very valuable in determining the parasites of fish, as the descriptions are very complete. In reading the diagnoses, however, one should remember that Linton unintentionally misused the word "lateral." In places where that word occurs, "dorsal" or "ventral" should be inserted. That Linton simply wrote lateral, by mistake, is proven by the fact that he speaks of the *breadth*

as the "*lateral diameter.*" It is impossible to mention here all of the curious and interesting species Linton has described; in several species of Dibothrium, for instance, the uterus empties *dorsally*, a point about which one would be inclined to be very sceptical, were it not that Linton gives drawings of the animals and exact measurements of the apertures. In one of his papers Prof. Linton determines the white pelican (*Pelecanus erythrorhynchus*) as the final host of *Dibothrium cordiceps* Leidy, the larval stage of which is found in the trout (*Salmo mykiss*) of the Yellowstone Park. The reviewer must differ from Prof. Linton in the interpretation of cysts in which these larvæ are found Linton interpreted them as *blastocysts*, but the histology described by the author gives more the impression that they are connective tissue and since the Reviewer has examined some specimens kindly sent to him by Prof. Linton to determine this question, he does not hesitate to state that we have connective tissue cysts of the host before us, instead of blastocysts. This point is very important, for were it a *blastocyst* as Prof. Linton thought, this species would form an exception in the family Bothriocephalidæ, for the blastocyst would of course be homologous to the cysticercus of Tæniidæ and the head would form in much the same manner. As it is, *not* the cyst, but the enclosed larva, is the homologon of the cysticercus.

The family Taeniidae has been undergoing considerable revision at the hands of the noted French zoologist, R. Blanchard. In a work (112 pp.) entitled Histoire zoologique et medicale des Teniides du genre Hymenolepis, Paris, 1891, Blanchard separates all these tape worms from the genus Tænia, which have three testes in each segment, with genital pores on the left border (for further particulars of the diagnosis, see the original). *Hymenolepis nana* and *H. diminuta* are of particular interest since they occur in man, and *H. murina* (according to Grassi identical with *H. nana*), since Grassi has shown that in this form we have a remarkable exception to the rule of development of the Tæniidae, in that *H. murina* develops *indirectly* but *without change of host.* The following is a synopsis of the species admitted by Blanchard to the genus Hymenolepis. (See Table on pages 67 and 68.)

In his notices Helminthologiques (Mem. de la Soc. Zool. de France, 1891, p. 420-480) Blanchard separates those members of the genus Taenia which have armed suckers into three new genera. 1, *Echinocotyle* R. Bl., '91. Rostellum with 10 large hooks, each sucker with a circle of spines on the edge and a longitudinal row in the middle, etc. 2, *Davainea* R. Bl. and Railliet '91, Rostellum or infundibulum with double row of hooks, each sucker surrounded with several circular rows of hooks. Corpuscles made up of conglomerations of eggs are

Adult Stage.	Host.	Larva.	Secondary Host.
1. H. murina Dujardin, 1845.	Mus decumanus M. pumilus M. musculus Myoxus quercinus	Cercocystis(Grassi)	Same as primary host, villosities of the intestine.
2. H. nana von Siebold, 1853. Syn. Taenia nana v. Sieb. (nec. P. J. v. Beneden, 1861.) T. aegyptiaca Bilharz., 1852. Diplacanthus nanus Weinland, 1858. T. (Hymenolepis) nana R. Leuckart, 1863.	Homo	?	?
3. H. microstoma Dujardin, 1845.	Mus musculus M. rattus	C. tenebrionis Villot	Tenebrio molitor
4. H. furcata Stieda 1862.	Crocidura aranea	?	?
5. H. uncinata Stieda 1862.	Cr. leucodon Cr. aranea	Cercystis(Bl.)Urocystis (v. Linstow.)	Silpha laevigata
6. H. scalaris Duj., 1845.	Cr. aranea	Staphylocystis biliaris, Villot	Glomeris limbatus
7. H. pistillum Duj., 1845.	Cr. aranea	St. micracanthus Villot	Glomeris limbatus
8. H. tiara Duj., 1845.	Cr. aranea	?	?
9. H. erinacei Gmelin, 1789. Syn. Halysis erinacei Zeder, 1803. Taenia tripunctata Braun, 1810. T. compacta Rudolphi, 1810.	Talpa europaea	?	?
10. H. bacillaris Goeze, 1782. Taenia bacillaris Diesing, 1851, proparte.	Vesperugo serotina	?	?
11. H. acuta Rud, 1819. Syn. T. obtusata P. v. Ben. 1872. nec. Rud. 1819.	V. noctula	?	?
12. H. decipiens Dies., 1850.	Chilonycteris rubiginosa Molossus perotis	?	?

B Unarmed Hymenolepis, *i. e.* Adult without hooks.

13. H. relicta Zschokke, 1888.	Mus decumanus	Cercocystis	Asopia farinalis
14. H. diminuta Rnd., 1819.	M. decumanus		Anisolabis annulipes
Syn. Taenia diminuta Rud., 1819.	M. rattus		Axis spinosa
T. leptocephala Creplin, 1825.	M. musculus		Scaurus striatus
T. flavopunctata Weinland, 1858.	M. alexandrinus		
T. varesina Erm Parona, 1884.	Homo		
T. minima Grassi, 1886.			

scattered through the parenchym. Most of the species of this group are parasites of birds, *D.* (*Taenia*) *madagascariensis* however is parasitic in man. 3, *Ophryocotyle* Friis, 1869. Rostrum absent, infundibulum present, its border armed with several rows of small hooks. Several transverse rows of hooks on the suckers.

The subfamile Anoplocephalinae R. Bl., '91, contains the unarmed Taeniæ found in herbivorous animals, segments wider than long, egg with pyriform apparatus, 3 genera. 1, *Bertia*, R. Bl., '91, genital pores irregularly alternate, etc., 2 species, found in primate anthropoides, (Mem. cit. p. 186-196). 2, *Moniezia*, R. Bl., '91, two genital pores to each segment, etc., (Bul. cit. p. 444) contains 11 species many of which are important to economic zoology: *M.* (*Taenia*) *expansa* and *M.* (*T.*) *denticulata* of sheep and cattle, etc. 3, *Anoplocephala* Em. Bl., 1868, sexual pores unilateral, etc., contains 2 species: *A.* (*Taenia*) *mamillana* and *A.* (*T.*) *perfoliata* of the horse, etc.

In the same publication R. Blanchard treats more minutely several species of the genus *Moniezia* found in rodents and gives some shorter observations on various Distomes.—C. W. Stiles.

Nematodes.—Willach (Arch. f. w. u. pr. Thierheilkunde, 1891, p. 340-346) describes a new and dangerous parasite, found in nodules of the colon of *Macacus cynomolgus*. This helminth, which receives the name of *Sclerostoma apiostomum*, proved fatal in two out of three cases examined. Stiles (Sur la Dent des Embryons d'Ascaris; Bull. d. l. Soc. Zool. d. France, 1891, p. 162) claims that the so-called "boring tooth" found in embryos of *Ascaris lumbricoides* is composed of three parts, each of which corresponds to a lip of the adult Ascaris.—C. W. S.

Notice of Trematode Parasites in the Crayfish.—Prof. Charles A. Davis, of Alma, Michigan, has submitted to me for identification several cysts from the common crayfish, which prove upon examination to contain immature trematodes. They belong to the genus Distomum and are evidently specifically identical with the specimen described and figured by R. Ramsay Wright in volume XVIII of the AMERICAN NATURALIST, pp. 429—430. Prof. Wright's description is based on a single specimen which he obtained from a cyst in the ovary of a crayfish. He referred it to the species *Distomum nodulosum* Zeder. This species has been found in the cercaria stage in *Paludina impura* by Von Linstow. In the adult stage it is found free in the intestinal canal of several European fresh-water fish (Perca, Esox, Etc.,) and encysted on the outer surface of the intestine of one (*Acerina.*)

The specimens for the most part appear to be a little younger than Prof. Wright's specimens, but the larger ones agree with it in every essential particular. The largest specimen observed, measured, when freed from its capsule and straightened out, 0·1mm. in length. The diameter of the head was 0·4mm. when seen in ventral view. The neck was 0·3mm. in diameter. The body was contracted until it was nearly circular in outline and measured 0·6mm. in breadth. The head bears six papillary appendages. Two of these are lateral, somewhat triangular in shape and project from the anterior edges of the sucker. In the largest specimen observed these measured about 0·2mm. in length. The other four papillæ lie on the antero-dorsal side of the head. They are flattish, bluntly-rounded, 0·1mm. broad and 0·15mm. in length. The oral sucker is considerably larger than the ventral. The former is about 0·3mm. by 0·2mm. in its two diameters, the antero-posterior diameter being the longer. The latter is 0·2mm. in its transverse diameter and a little less than this in its antero-posterior diameter. In another specimen the anterior sucker was 0·36mm. long and 0·3mm. broad, and the ventral 0·2mm. long and 0·24mm. broad. The testes are about 0·2mm. in length. The anterior end of some of the smaller specimens appears to be invaginated.

The cysts are globular. Each specimen when freed from its connective-tissue shell, is found to be enclosed in a thin pellicle. The diameter of the pellicular cysts is, in most cases, about 0·5mm.

Prof. Wright states in the article alluded to above, that the structure of the mouth sucker of his specimen is not entirely in accordance with Von Linstow's description. While my specimens agree so closely with Prof. Wright's that I have no hesitation in regarding them as

identical, I do not find it so easy to refer them to *D. nodulosum*, as described by Von Linstow, Archiv f. Naturg., 1873, XXXIX, where the larval stage from *Paludina impura* and the adult from *Perca fluviatilis* are figured. The same difficulty is experienced when they are compared with Olsson's account, Bidrag till Skand. Helm., pp. 23—24. Taf. IV. fig. 51, where a side view of the head of an adultis figured.

The cysts were found "about the heart, intestine and other organs in the hinder part of the thoracic region." They were collected in December 1891.

It cannot be concluded, from the specimens at hand, that the crayfish is a proper intermediate host of this parasite, although the considerable number of cysts and the different degrees of development of their contents make the inference not altogether improbable that they are genuine guests and not strangers which have strayed into an unusual host.—EDWIN LINTON, *Washington and Jefferson College, Washington, Pa., Dec.* 31, 1891.

Branchiostoma elongatum Sundevall at San Diego, California.—In 1868 Cooper described three specimens of a *Branchiostoma* which he obtained near La Playa in San Diego Bay in 10 fathoms of water. Since then *Branchiostoma* has not again been recorded from the Pacific Coast of America. Last Summer on visiting a dredge which was at work in San Diego Bay near Ballast Point about a hundred specimens were obtained. On subsequent visits to the dredge Mr. L. C. Bragg found them in greater or less abundance.

The specimens were all large, some of them reaching $3\frac{1}{4}$ in. in length. But very few of them were sexually mature July 1st. Surface skimming never brought the eggs or larvæ. There are about 70 (from 68—75) myocommata arranged as follows: 45 to atrial pore; 16 from atrial pore to anus; 9 behind anus.

The species may be identical with *Branchiostoma elongatum* Sundevall from the coast of Peru, as Dr. Jordan has suggested. The formula differs however, the myocommas in the Peruvian specimens being 49+18+12.

To those engaged in teaching it may be of interest to know that specimens of this Amphioxus may be obtained of Mr. L. C. Bragg, Coronado Beech, California.—C. H. EIGENMANN, *Bloomington, Indiana.*

On the Presence of an Operculum in the Aspredinidæ.—In our "Revision of the South American Nematognathi" (p. 9) we defined the Bunocephalidæ=Aspredinidæ as having no opercle. In this we followed Cope, who separated the Aspredinidæ from the remaining Nematognathi by their lack of an opercle.

We have lately obtained a specimen of *Aspredo aspredo* Linnæus from the Museum of Comparative Zoology and have re-examined this point. The closer inspection has demonstrated the presence of a minute operculum attached to the upper posterior border of the expanded hyomandibular. It is movable in moist preparations but becomes immovably fixed with drying, which may have led to the original statement. The interopercle is about as large as the opercle and apparently immovably joined to the hyomandibular and preopercle. Brühls "Osteologisches aus dem Pariser Pflanzengarten" 1856, contains the only figures published of the skull of *Aspredo*. Since these figures are inexact in several respects I add a figure of the dorsal aspect of the skull, etc. of *Aspredo aspredo*.—C. H. Eigenmann.

The Barn Owl in Minnesota.—Three barn owls, *Strix pratincola*, were recently taken from a hollow tree near Waterville, Minnesota and are still alive and in possession of Chas. A. Gray of that place. The fact is interesting since barn owls are scarcely ever found this far north.

Mr. Gray says, "The birds are as healthy and strong as when I got them. They dislike cats and dogs and make a hissing noise when these animals are near. When alone at night they make the same noise with a gurgling sound. When I talk to them they sway their bodies back and forth like some wild animals in cages. They live on rabbits and birds, are very tame and like to be petted as much as a dog."

As is often the case, these birds have excited considerable curiosity and photographs have been taken and sent to several places.

—U. O. Cox.

The Ruffed Grouse in Hudson, Ohio.—This is a small village with an area of two and a half square miles and a population of about 1200.

Three years ago in September a Ruffed Grouse (*Bonasa umbellus*) was observed in the central part of the village feeding upon grapes on a vine covering the top of an apple tree. By common consent, care was taken that it should not be disturbed or frightened. It remained

during the fall and winter, most of the time in the same block. It has returned each fall and remained until spring, and is now with us. It forages about the dwellings; feeding on the vines of the barberry, ampelopsis etc.; picking the white clover on the lawns and towards spring feeding on the buds of the apple trees. There are a few houses around which it delights to forage, where its tracks in the snow are to be seen at daylight and where it is often seen by day. It moves about with the characteristic caution of the wild bird, but has lost much of its timidity, as one can approach within 10 or 12 feet of it without disturbing it. Our hopes that it would return some fall with a mate have not been realized. The familiarity of the returning bird with its old favorite haunts, establishes its identity.

—M. C. READ.

On some Peculiarities in the Structure of the Cervical Vertebræ in the existing Monotremata.—For a long time I have been acquainted with the peculiar fact that the cervical vertebræ of Ornithorhynchus and Echidna are devoid of præ and postzygapophyses. In these forms therefore the cervical vertebræ are only connected with each other by the centra of the vertebræ and not by the arches. I do not know whether this condition is mentioned by Gervais, in his Osteographie des Monotremes, 1877, this work being not at hand. But since it is not noticed by Flower and Lydeker in their work, An Introduction to the study of Mammals, Living and Extinct, London 1891, nor in Flower's Osteology of Mammals, I should like to call the attention to it. I have observed this peculiarity in all the living forms of the Monotremata: *Ornithorhynchus, Echidna, Proechidna,* and it is very interesting to see that the same condition is found in two families so completely separated. I do not remember a similar case among any of the higher vertebrates.—G. BAUR, *Clark University, Worcester, Mass., Jan.* 11, 1892.

The Armadillo (*Tatusia peba*) **in Texas.**—It may be of interest to some of your readers to know that the Armadillo, which has been supposed to occur in Texas only in the extreme south-west, is gradually ranging eastward.

During the past Summer a specimen was taken within a few miles of Austin and is now in our museum. Several have been seen on Onion Creek just south of here and they are quite numerous on the Navidad river in Lavaca County east of the ninety-seventh degree of longitude.—E. T. DUMBLE, *State Geologist.*

The Arachnoid of the Brain.—In the N. Y. Medical Record, Aug. 15, 1891, Dr. F. W. Langdon publishes some new observations on the Arachnoid of the Brain which are summarized as follows.

"1. The arachnoid membrane is a true shut sac, similar in structure and function to the serous membrane of the other great cavities. Its parietal layer is easily separable from the dura at the vertex in the fœtus and young infant, but practically inseparable in this region in the adults. At the base of the skull it is demonstrable as a separate membrane even in the adult. To assert that the parietal layer of the arachnoid is absent, because its subepithelial connective tissue has fused at the vertex with the dura (connective tissue) is as incorrect as to describe the great omentum as one layer of peritoneum, because its original four layers have become matted and adherent."

"2. The arachnoid cavity communicates freely with the subarachnoid space, by means of two foramina situated in the visceral arachnoid, one on either side of the medulla. For these I would propose the name 'lunulate foramina,' from their crescentic or lunulated edges, produced by the attachments of fibrous bands which cross the openings transversely. Subsequent observations, in two instances, confirm the presence of the 'lunulate foramina.' In one of these, the basilar process of the occipital and the sphenoid body were cut away from the base and the dura removed, so as to show the foramina *in situ*; thus excluding the possibility of their artificial production during the extraction of the brain."

EMBRYOLOGY.[1]

On the Development of Nereis dumerilii.[2]—Though this is but the first part of a contribution to the development of Annelids, to be followed by an account of the formation of the organs, yet the untimely death of the author makes it almost necessary to regard the present contribution as complete.

The very interesting series of forms discovered by Claparède in this single species, *N. dumerilii*, have been again studied by the present author, who believes their interrelations to be the following:

A small Nereis 12-15 mm. long in an immature state may have two quite different fates. It may transform in September and October into a pelagic Heteronereis, becoming sexually mature in February and March, and depositing pelagic eggs that contain little yolk and develop *with a metamorphosis;* it may grow to a length of 15-30 mm. and then become sexually mature as a Nereis laying eggs in tubes in April to July, which eggs contain much yolk and develop *without a metamorphosis;* or still growing, in June and July become a Heteronereis 55-65 mm. long that lays eggs in tube, with little yolk and *probably* developing with a metamorphosis.

There are thus two *Heteronereis states*, a little one with pelagic habits and metamorphosis and a large one without any pelagic life, and unknown, probably, indirect development. There are two *Nereis states*, one small and immature, the other large and either on the road to the large Heteronereis state or becoming a sexual Nereis with a direct development. It is this last large sexual Nereis that is treated of in the present article.

Obviously much yet remains to be done here by one having control of aquaria for long periods, as it is still unknown what may be the causes leading to the acquirement of these various states or whether there is any regular sequence or alternation in their occurrence. This could be done upon the common, equally polymorphic, Nereis of our coast!

In all forms of *Nereis dumerilii* the sexes are separate. In the large Nereis state studied, the females readily lay the eggs in transparent tubes (secreted by the parapodial and other epidermal glands)

[1]Edited by Dr. T. H. Morgan, Bryn Mawr, Pa.

[2]Dr. C. V. Wistinghausen in Mitth. Zool. Sta. Neapel. 10, July, 1891, pp. 41–72. Pl. 6–7.

when kept in aquaria with ulva, which they eat. The male enters the tube only to fertilize the eggs as they are laid. From the tubes the eggs may be removed with care from holes cut in the side; but the female must not be disturbed, as the undulatory movements of its body within the tube are necessary in supplying the eggs with fresh water.

When no male is present the females abandon the tubes and lay the eggs at random in the water, where they do not develop.

No time limits can be set to the processes of development, as they vary so exceedingly at different temperatures. It is interesting to note that the author finds the Winter season very unfavorable, since a large proportion of the eggs then develop abnormally in the laboratory, but not outside. This would seem another illustration of the advantage derived from a climate in which air and water are of about the same temperature. At Messina the eggs are laid, in aquaria, between eleven and twelve in the morning regularly, this being a decided exception to the many cases in which the night time is the laying period.

In the investigation both surface views and sections were made use of, the former either alive or stained in Kleinenberg's hæmatoxylin after hardening in picro-sulphuric, while the section material was hardened in Fol's modification of Flemming's fluid.

The author's summary of results obtained is about as follows: Cleavage is total and unequal; four blastomeres bud off four micromeres called *encephaloblasts*, as they give rise to the cephalic ganglia and all the sense organs of the head. The largest of the four micromeres buds off *two* large cells called *somatoblasts*, as they form all the body except the mid gut and the epidermis. The three other micromeres, equal in size, bud off each two small cells, and these *six* micromeres take no part in the formation of organs, but merely form the epidermis and the larval prototroch.

The embryo arises from two quite separate masses, the one, the trunk arising from the two somatoblasts, the other, the head, formed by the four encephaloblasts. These two elements subsequently unite. The embryo is hatched with three pairs of functional parapodia, the development being thus direct.

Without the aid of the author's figures it is difficult to explain many of the points of interest in the paper, not all of which are included in the above summary.

The large amount of yolk present remains in four masses, the micromeres, which are epibolically overgrown by a very thin layer of nucleated protoplasm furnished by the cells budded off from the mic-

romeres, namely the four encephaloblasts, two somatoblasts and six micromeres.

These four micromeres form the digestive tract, the other cells the ecto- and mesoblasts. The four yolk masses at first have but one nucleus each, but subsequently by what seems amitotic division, new nuclei, accompanied by a little protoplasm, arise in the yolk and envelops it in such a way as to preserve the original lines of cleavage between the four masses. These come to lie around, not in, the digestive tract, the yolk being still in four masses in the latest embryo.

The persistence of these cleavage planes of the micromeres enables one to refer them to the subsequent planes of the animal.

The animal pole is anterior, and the first two meridianal planes result in the formation of two smaller central cells and a small and a larger dorsal cell, the larger cell being on the left of the animal.

Without entering into the author's comparison between the phenomena found in this Nereis and those recently discovered in other Polychætæ, Oligochætæ and leeches we must refer to the way in which the two somatoblasts give rise to the trunk as it bears upon the question of "teloblasts." The first formed somatoblast divides into four cells in a transverse row, and these again divide to form a parallel row from which other cells bud off, making twelve in four longitudinal rows, two on each side the median plane. The division of the second somatoblast results in the formation of three transverse series, of which the upper is composed of five or six larger cells that seem to give off the other cells in longitudinal rows. These six larger cells sink in and as *myoblasts* form the musculature, while all the other descendants of the somatoblasts form nervous system, setæ sacs, etc.

Obviously all these cells represent the "ventral plate" found by Wilson in a Heteronereis, while the two somatoblasts are identical with the "primary toloblasts," though Wistinghausen seems to avoid the use of the term teloblast as long as there are no long lines of cells leading directly from a mother cell to the formed organ.

The prototroch forms but a rudimentary simple band of ciliated cells rotating the embryo. The anus would appear to arise at the point of closure of the blastopore. The formation of organs in the trunk, on the surface of a spherical mass of yolk has much to recall stages in the embyology of an arthropod. Finally the head and trunk organs unite when the œsophageal commissures are formed by growths from both foundations.

The embryo elongates and hatches in an imperfect state with three pairs of setigerous parapodia, partly formed fourth somite, head and tail, anal and cephalic tentacles.

A just estimate of the paper can be formed only with the appearance of the full account of the American species studied by Wilson. From the preliminary account it seems that, allowing for the differences due to a direct and an indirect development and the difficulties offered by an opaque as opposed to a transparent object; the embryology of these two species of Nereis has very much in common, strengthening the theoretical conclusions that may be drawn from either and rendering of little use the previous imperfect studies of the same subject.

Development of the Lobster.[1]—Mr. H. C. Bumpus publishes a contribution to the Embryology of the American Lobster. Many females seem to be impregnated with spermatozoa long before they are able to deposit eggs, which cannot take place until a year if not two years later. The author has discovered in the female a receptive apparatus for the spermatozoa. "This organ lies at the posterior end of the sternum of the female lobster, resting between the bases of the IV and V pairs of thoracic appendages."

The eggs are deposited (on abdomen) in July and August, and develop rapidly so long as the water is relatively warm. Certain precocious eggs may exceptionally hatch before winter. This is not the rule, for ordinarily the eggs hatch between the middle of May and the middle of July of the following year.

The nucleus of the egg divides and re-divides before the protoplasm (and yolk) of the egg shows any traces of division. When nuclear division has taken place about three time elevations and furrows appear on the surface, at first only at the animal pole.

Later the lower pole is divided and all the furrows extend deeper into the yolk, "though there is shown a central mass of yolk that remains undivided." On the third or fourth day after oviposition the Gastrula is formed.

The rest of the paper deals with the later stages of development.

Embryology of the American Alligator.—Dr. S. F. Clark publishes in the September number of the Journal of Morphology[2] a paper on the habits and embryology of the American Alligator. The

[1]Journ. Morph., Vol. V, No. 2.
[2]Journ. Morph., V, No. 2.

first part of the paper deals with the author's visits to Florida and his own and others' observations on the habits of the alligator.

The times of laying lie between June 9th and 17th, "while it is probable their eggs are occasionally laid somewhat later. I doubt if they are ever laid much before the 9th."

The nest is very large and is built by the female, and it is probable that the same nest may be used more than once but not more than once each year.

In counting lots of eggs the number averaged twenty-eight each. Fine plates accompany the paper giving the superficial structure of the stages of development. Unfortunately none of the internal changes are given, and the text is a very brief description of the fifty-one figures.

The author's purpose is to furnish a general account or outline of the forming of the alligator as seen in external features.

"I have been led to do this by reason of the entire lack of any embryological knowledge of the alligator group, and on account of there still being something to be desired in the way of a set of general figures illustrating the development of a reptile."

ENTOMOLOGY.[1]

The Ox Warble Fly.—*The Journal of Comparative Medicine and Veterinary Archives* for June, 1891, contains an article by Dr. Cooper Curtis upon the "Oxwarble in the United States." Dr. Curtis reviews the literature of the subject and shows that what American writers have thought to be *Hypoderma bovis*, is really *H. lineata*. Larvæ of this insect having been found in the œsophagus, under the pleura near the eleventh rib, and in the subcutaneous tissue of the back, led Dr. Curtis to conclude that the life history of this insect is not as has been supposed; i. e. that the eggs are laid along the backs of cattle, and upon hatching, the young larvæ bore into the skin. If no larvæ or "wolves" are found in the backs of cattle until January, it is probable that the eggs are taken into the mouth and the larvæ go from the œsophagus to the back.—Howard Evarts Weed, *Mississippi Agricultural College.*

Spontaneous Ignition of Carbon Bisulphide.—According to a recent issue of the *Scientific American Supplement*, Dr. Max Popel

[1]Conducted by Prof. C. M. Weed, Hanover, N. H.

recorded a case in which carbon bisulphide mixed with air was ignited by an arm of the pipe through which it was passing being unscrewed. Dr. Popel has also found that "mixtures of carbon bisulphide and air readily ignite when brought into contact with iron pipes through which steam at ¾ atmosphere (135°—145° C.) is passing, the less carbon bisulphide there is in the mixture the higher is its ignition point, and the sharper the explosion." This substance is now extensively used to clear mills of insects, and the caution is common to see that no fire in any form reaches the rooms where it is in use. The facts above given emphasize the necessity not only of cautioning against fire, but also against the presence of steam or hot water pipes; and perhaps also against making the treatment on a hot summer's day.

A Collection of Exotic Insects.—I recently had the pleasure of looking over a magnificent collection of exotic insects, owned by Mr. John D. Locke, of Haverhill, New Hampshire; and was surprised to find so rare a lot of insects known to very few entomologists. The collection was purchased by Mr. Locke, who is an enthusiastic naturalist, a few years ago in Vienna, of the widow of a Professor Schneider, the latter having spent a life-time in getting it together. The collection consists chiefly of Lepidoptera and Coleoptera, and contains specimens from all over the world. Many of the butterflies, moths and beetles are of gigantic size: e. g., the Atlas moth from India, which measures 9x6½ inches; *Erebus agropyrus* from South America which measures 10 inches across the wings; *Phaomagigas*, a "lantern fly" which is 10 inches long, and the mammoth Goliath beetles which must be seen to be appreciated. Fortunately the collection is in good hands, and is carefully gone over at stated intervals and kept free from pests and dust.—CLARENCE M. WEED.

Entomological Notes.—The Horn Fly (*Hæmatobia serrata*) according to a recent report from Mr. H. E. Weed, of Mississippi, has appeared in that state in sufficient numbers to attract the attention of farmers. It seems destined to spread widely and rapidly.

Professor A. J. Cook is to spend the Winter in California.

In a recent *Nature* we find this item: "Every one interested in the scientific aspects of agriculture was sorry to hear that Miss Ormerod had felt it necessary to resign her position as consulting entomologist of the Royal Agricultural Society. It is much to be regretted that misunderstandings should have led to the severance of her connection with the Society with which she has so long been hon-

orably associated. Fortunately her work as an entomologist is not to be interrupted, and she will continue to place her knowledge at the service of agriculturists."

The newspapers report that a large manufacturing building at Springfield, Illinois, has been riddled by an insect borer, apparently a small beetle.

MICROSCOPY.[1]

A New Method of Using Celloidin for Serial Section Cutting.—The following has several features which recommend it as preferable to the ordinary methods of section cutting.—It allows a perfect orientation; the entire object is visible during the process of cutting; yolk-bearing eggs offer no serious difficulty; sections of large area and of unusual thinness are easily secured; crimping and curling during the process of clearing are avoided and the sections may be readily arranged in series.

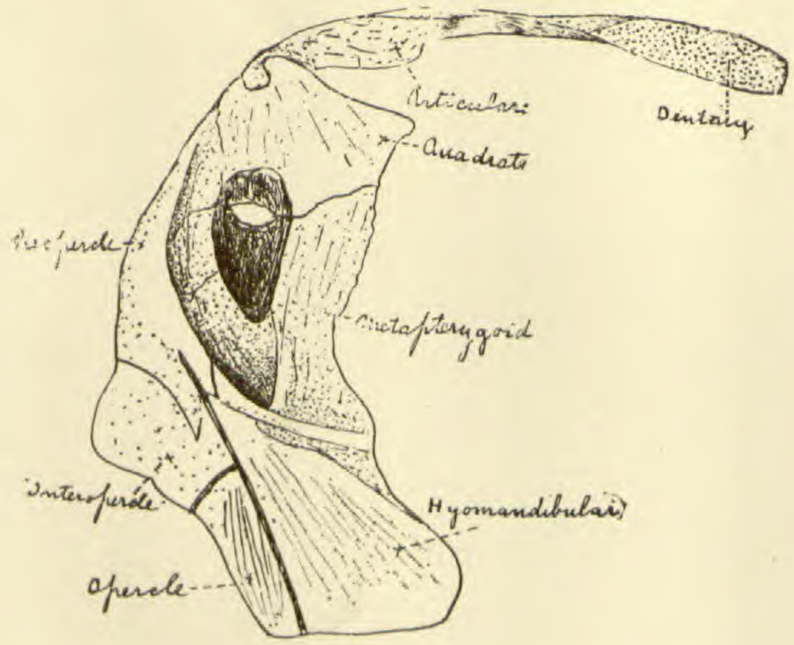
The object is first stained *in toto*, dehydrated, infiltrated with thin, medium and thick celloidin or collodion, (Squibbs Flexible Collodion rendered thick by evaporation is excellent) and finally placed in a paper tray filled with the thick collodion. In a few moments a film will form over the exposed surface of the collodion, when the paper tray with its contents is thrown into a jar of strong chloroform, in which after a few hours, the collodion becomes quite hard. Thus far we have been following only the more ordinary methods.

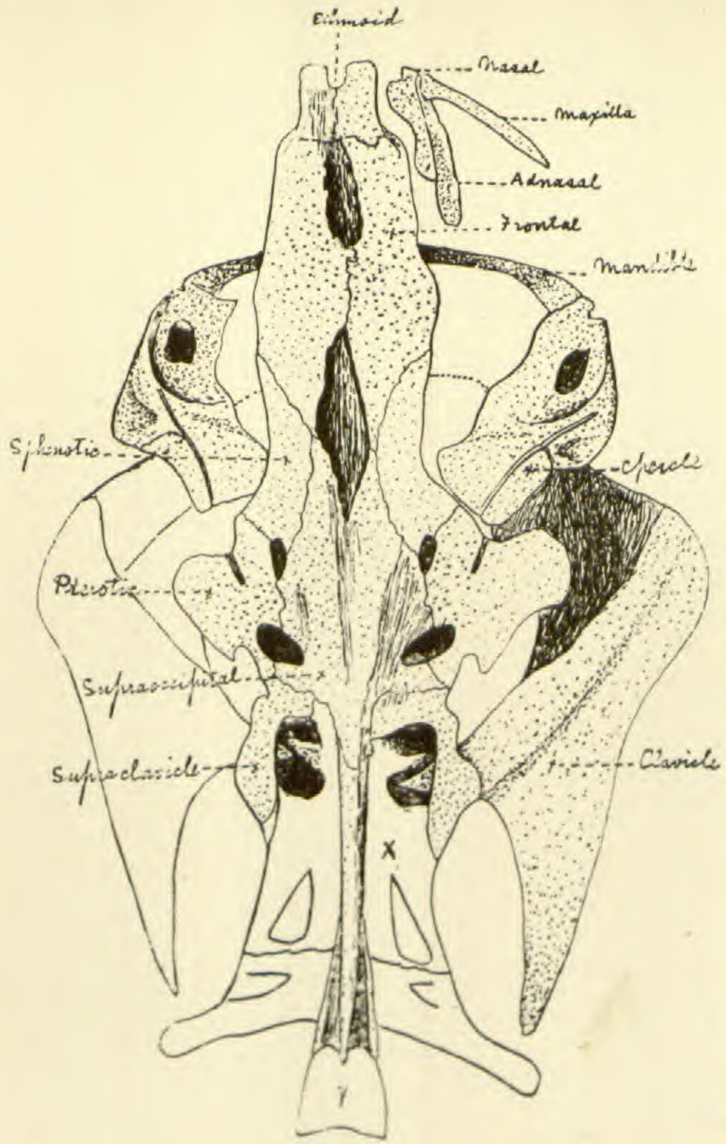
The tray is now taken from the chloroform and, after the paper has been removed from the hardened block, the collodion with its enclosed object is placed in a vial of white oil of thyme, or some other similar oil. If the block of collodion is not large, in a few hours it will become as clear as glass, the stained object appearing as if suspended in a transparent fluid.

For the process of orienting, the block of collodion may now be taken from the oil, placed in a watch crystal and, after covering with the oil of thyme, examined with a lens or, if more desirable, with a compound microscope. The side of the block that is to be attached to the object holder of the minotome is now selected, wiped dry of the oil and immersed for a moment in ether and then smeared with thick collodion. The object holder, a block of wood rather than cork, is

[1]Edited by C. O. Whitman, Clark University, Worcester, Mass.

PLATE VI.





Skull of Aspredo.

smeared in the same way and the two collodionized surfaces are brought together. The holder and collodion block are now immersed for a few minutes in chloroform, or long enough for them to become firmly united.

The preparation is now screwed between the jaws of the object-carrier of the minotome and covered, by means of a camel's hair brush, with oil of thyme. The minotome knife is flooded with the same oil. The oil, which thus takes the place of alcohol usually used, has the advantage because of its lubricating property, of not only permitting thin sections to be cut, but its slow evaporation allows one to leave his work at anytime for minutes or even hours without the object being injured.

After a few sections have been cut from the block of collodion, the relative position of the plane of the knife to the axis of the object can be definitely established. I have had no difficulty in orienting small Arthropod embryos by simply examining the object and plane of cutting at this time with a compound microscope. The segments, appendages and even nuclei being as clearly shown as if mounted in balsam.

The object, satisfactorily oriented, is now cut and the sections at once transferred to the slides, covered with balsam and mounted, or, if they are not immediately needed, they may be kept indefinitely in a vial of the oil.

If the sections are to be arranged 'in series,' they are simply placed upon a slide one after the other, care being taken not to flood the slide with oil but to keep it quite dry. After the sections are arranged, the slide is tilted up to allow the excess of oil to drain away, fifteen minutes generally being sufficient. Balsam is now placed on the sections and a warm cover is allowed to gently fall over the series, no section of which ought to leave its place.

The above method is especially useful in the preparation of larger yolk-bearing eggs.—H. C. Bumpus, *Brown University, Prov., R. I., Dec.*, 14, 1891.

Imbedding Blastoderm of Chick in Collodion.[1]—For sectioning, blastoderms should be dehydrated, either before or after staining, as is thought best, and immediately transferred to a thin solution of collodion[2] (2 per cent.,) after which they are placed in a

[1]Gage & Hopkins, Proc. Am. Soc. Microscopist, 1890, p. 129.

[2]We have found collodion more satisfactory, on the whole than celloidin and it is less costly.

To make a two per cent. solution, dissolve 2 grams of gun-cotton in 100 c. c. of sulphuric ether and 95 per cent. alcohol, equal parts of each. For a 5 per cent. solution use 5 grams of gun-cotton instead of 2.

thick solution of collodion (5 per cent.) and then arranged for imbedding and sectioning. To accomplish this, the following procedure has been found useful:

With a camel's hair brush transfer the blastoderm from 95 per cent. alcohol to a paper box. It is better to fill this box partly full of alchohol (95 per cent.) before transferring the blastoderm to it, as the alcohol partially floats the blastoderm and thus facilitates its removal from the brush. As soon as the blastoderm is safely in the box, remove the alchohol with a dropper (do not try to pour it off, otherwise the blastoderm will curl up) and carefully pour in enough thin collodion to cover the blastoderm to the depth of about ½ c.m. The box is now placed in a tightly covered jar to prevent too rapid evaporation and the consequent solidification of the collodion. After the blastoderm has remained a sufficient length of time (from one to three or more hours, depending on the size of the blastoderm) in the thin solution, the collodion is removed with a dropper, and the thick solution poured on. After infiltrating sufficiently with thick collodion, 2 to 10 hours, open the jar and allow a film to form on the surface of the collodion, then fill the paper box with alcohol (60 to 80 per cent.) and allow it to remain until the collodion becomes firm and tough; two to four hours is usually sufficient. Now with a sharp knife a square or rectangular piece of collodion including the blastoderm is cut out and arranged on the cork in any position desired; the block is fastened to the cork, as any ordinary tissue, by simply pouring over it thick collodion, which is hardened by immersing in alcohol (60 to 80 per cent.) for from 5 to 15 hours.

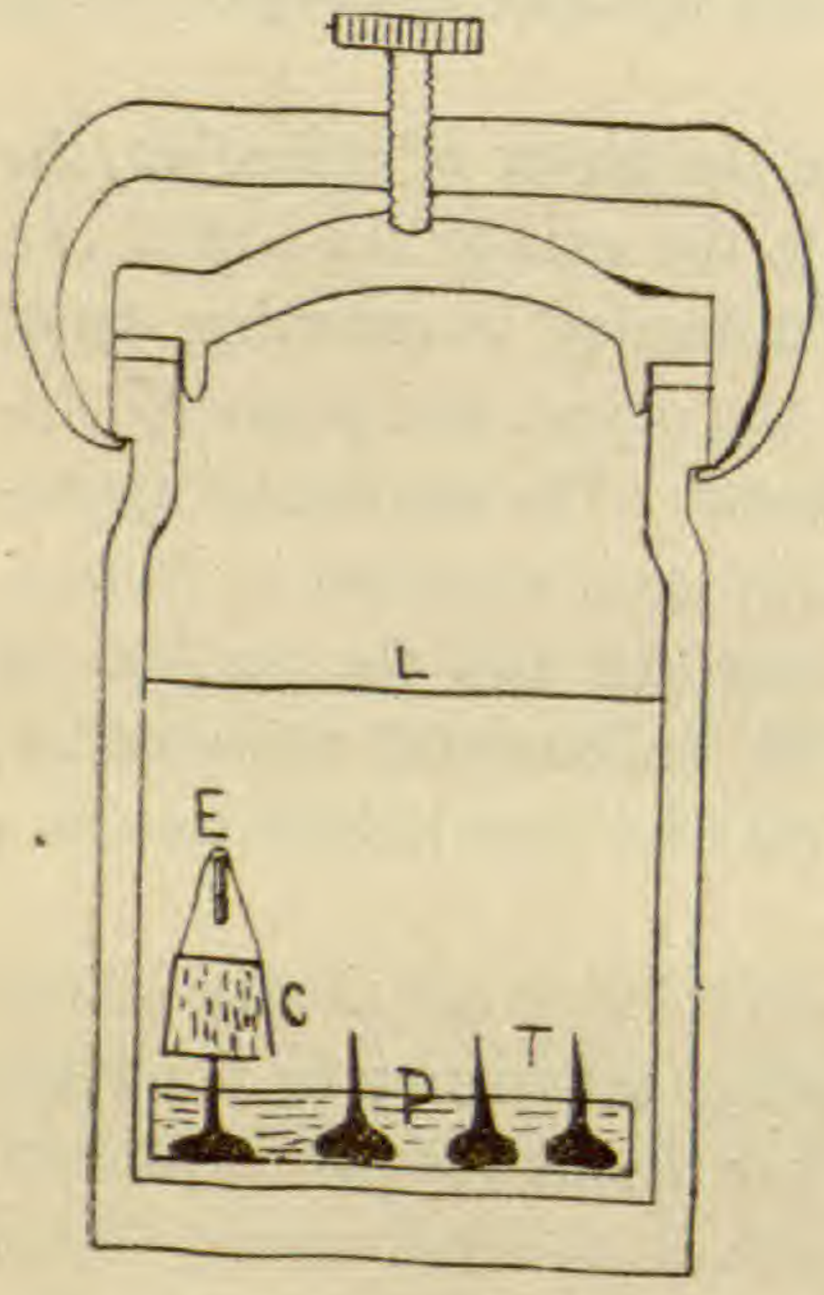


FIG. 1. Jar for hardening the collodion, of collodion-imbedded objects.

(P) Plaster of Paris disc, in which are imbedded the glass tacks. The cork (C), on which the embryo (E) is imbedded, is pushed down upon a glass tack (T), and is held in position under the liquid (L), alcohol or chloroform, while the collodion is hardening.

For holding the corks under the alcohol the following apparatus has been found more economical and convenient than the method of

attaching weights to the corks. The apparatus consists simply of a glass jar, in the bottom of which are fastened several rows of glass tacks. The material necessary for its construction consist of a wide-mouthed jar, a few pieces of glass rod, and a little plaster of Paris. The tacks are made by heating the glass rod and drawing it out to a rather sharp point. It is then cut off at the right length and the cut end softened by heat and then quickly pressed upon some hard surface, so as to form a sort of head. The tacks are then arranged in rows in some shallow dish, previously oiled, and enough plaster of Paris poured around them to form a

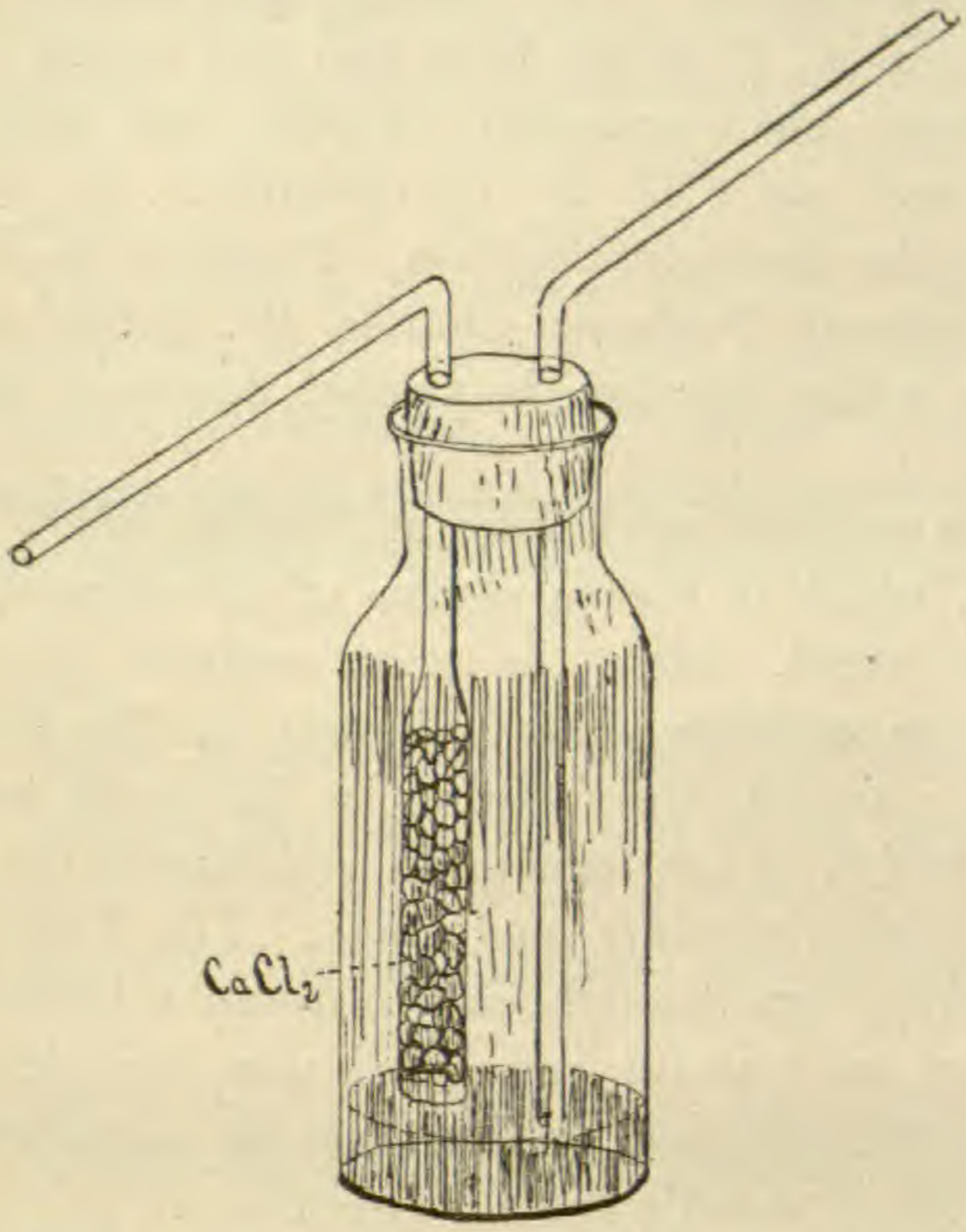


FIG. II. Ether wash-bottle for blowing ether vapor upon collodion or celloidin sections to fasten them to the slide. The tube of calcium chloride (Ca Cl 2) is for dehydrating the ether vapor.

layer 1½ to 2 c.m. deep. When this hardens, the tacks are firmly held in an upright position, and all that remains to be done is to place the plaster disc in the bottom of the glass jar.

To use the apparatus, fill it partly full of alcohol (60 to 80 per cent.). As the specimens are imbedded on the corks, transfer them to this jar, sticking each cork upon a tack.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

The American Society of Naturalists—Met in Philadelphia, December 29th and 30th, 1891. They discussed a salient point in evolution on the morning of the 30th, and in the afternoon listened to the descriptions of three important expeditions which went out in 1891. The morning session was given up to the reading of four papers on "Definite vs. Fortuitous Variation in Animals and Plants." Professor Thomas Meehan, Professor J. P. McMurrich, Professor J. A. Allen and

Professor E. D. Cope each read papers on their separate specialties in reference to the subject under discussion. The meeting was called to order on the 29th, by the President, Professor Rice, and the report of the Treasurer of the society was approved. Among the other items in the Treasurer's report was $100 as a subscription to the "American table" at the Naples Zoological Station. Professor H. F. Osborn, of Princeton, introduced Professor Charles W. Stiles, of Washington, that the latter might describe the present status of the Naples Station.

Professor Stiles told of the excellent work done at Naples, where a laboratory has been erected, which is now a centre of investigation for naturalists all over the world. Here the most eminent scientists of all nations assemble to exchange views and study the life that teems in the Bay of Naples. Almost every nation in the world has made a subscription to the station in the form of an endowment for a "table," at which the distinguished scholars may study. The United States was represented for three years through the Smithsonian Institution, but for many years there has been no American table, and those American students who visit the Biological Station do so as a courtesy from foreign nations. The cost of a table is $500 a year.

The American Association for the Advancement of Science has made a donation of $100, which, with the present donation and one or two other gifts from colleges, will greatly aid the work, so that an American table will almost certainly be maintained in 1892.

Looking toward the future maintenance of this table, the Executive Committee recommended that the society memorialize the Smithsonian Institution, recommending that the Institution assume the responsibility of maintaining an American table at the Naples Zoological Station in future years. This recommendation was adopted.

The following members were elected: George V. McLanthalen, Massachusetts Institute of Technology: Henry B. Ward, Harvard College; Charles W. Stiles, Department of Agriculture, Washington; George W. Fuller,· Biologist, Massachusetts Board of Health; J. E. Ives, Philadelphia Academy; Robert P. Bigelow, Johns Hopkins University; Alexander H. Philip, Princeton College; Charles Freeman William McClure, Princeton College; William A. Setchell, Yale College; Joel A. Allen, American Museum of Natural History, New York; Henry A. Fernald, State College of Pennsylvania.

The Committee on Nominations recommended the following officers, who were unanimously elected: President, H. Fairfield Osborn, Columbia College; Vice-Presidents, Samuel F. Clarke, Williams College;

George Baur, Clark University; William H. Dall, Smithsonian Institution; Secretary, Thomas H. Morgan, Bryn Mawr College; Treasurer. William T. Sedwick, Massachusetts Institute of Technology; Members of the Executive Committee, J. Playfair McMurrich, University of Cincinnati; W. P. Wilson, University of Pennsylvania.

The papers of the session were then read in succession, a general discussion following. The subject under discussion was "Definite versus Fortuitous Variation." The subject is important to the naturalist as pointing out the method in which species are formed, whether as the result of definite or of purely accidental causes. The first paper was by Professor Thomas Meehan, and considered the question in reference to plants.

PROF. MEEHAN'S ADDRESS.—Professor Thomas Meehan remarked, in opening the discussion, that he was unable to get a distinct conception of definite as opposed to fortuitous variation, but would consider those variations definite that came in expected order and exerted no surprise, and those as fortuitous that were unexpected and unusual, as if influenced by some irregular law, dependent on accidental conditions.

A large number of American trees, he explained, had closely related species in the north of Europe. The American chestnut, he said, had for a relative the Spanish chestnut. It had smaller nuts, smaller twigs and buds, wider internodes, thinner and less serrate leaves, and changed to a bright color in fall. The two, it was assumed by evolutionists, had the same origin, only some accident, some fortuitous circumstance, led to the variation. Strange to say, all the other trees varied from their allies in just the same particulars. Could such a regular series of variations be due to fortuity? What is more remarkable, this departure from the primitive parent must have been ages ago, yet through the long centuries, and over thousands of miles of varying conditions, the distinct character of these variations has remained the same.

Reference was then made to a large number of variations known in gardens as cut-leaved kinds, blood-leaved, weeping trees, and sports like the nectarine from the peach, and garden roses from the sporting branches—the parents as being under exactly similar conditions, as one great difficulty in believing environment, as generally understood, could have had much influence in producing them. Popular language called these incidents, and science fortuitous, but the element of change must have existed in the organized protoplasm of the single cell, and it was difficult to conceive of any external influence that could act on this single cell and not on those surrounding it.

Water plants, with the varying characteristics in proportion to their growth on land or in water, were referred to, rather as hereditary powers of adaptation than as acquired ones. Carnivorous plants and parasitic plants were referred to in the same connection.

Professor Meehan urged, however, that there were very strong facts in favor of fortuitous variation, as there must necessarily be, to draw so strong a support of that view from eminent men. A comparison of some trees of the Rocky Mountains with identical species on the Pacific was made. They undoubtedly had a common origin within comparatively recent times, and the elevation following the upheaval of the Rockies, was assumed to be the fortuitous circumstance influencing the change. Some of these had wandered so far apart as to be regarded in some cases as distinct species. The hardiness of magnolias, sweet gums and others, from Northern seed, as against seeds of Southern trees, was also touched on. On the other hand, annual plants would not resist frost. The same white frost killed foliage in these as probably did long ages ago.

Heredity was then taken up and the point made that, no matter how originating, all variation was hereditary when once introduced. In this respect there was no difference between what was recognized as a good species or a mere variety.

Concluding, he said: "To my mind it would be unjust to ignore the separate existence of either fortuitous or definite variations. We have not the remotest conception how either of these forces operate on protoplasm. They may eventually be found but varied manifestations of the same power; but while we are arguing as we are to-day, arguing on the separate nature of these two forces, we must concede considerable power to both, with by far the larger influence, to my mind, to definite variation."

Invertebrate Animals.—Professor McMurrich followed with the discussion of the question with reference to invertebrate animals. He compared the question not inaptly to the rolling of a spheroidal body having a larger number of facets over a hard surface. If the ball was uniformly balanced it was a matter of "chance" that is to say, of a large number of causes which could not be determined or analyzed as to which facet it would stop at. If, however, the ball was weighted it would stop definitely on a single facet, or one close to the one selected.

"At present," he said, "there are no extensive observations recorded on the question under discussion, although there are certain special cases which seem to bear more or less directly upon it. The most

noteworthy of these is the series of observations made by Schmankewitsch, on the effect of the degree of saltness of the water in which certain animals live upon the form of the body. The form experimented upon was a rather lowly organized crustacean, known as *Artemia salina*, which normally lives in water of a moderate degree of salinity. By gradually increasing the saltness of the water, in the course of several generations, the animals assumed the characteristics of an entirely different species, known as *A. muhlhausenii*. By gradually diluting the moderately salt water with fresh water until it becomes practically fresh, the *A. salina* gradually assumed structural characteristics which rendered it necessary to refer the forms thus obtained to an entirely different genus, *Branchipus*. Here we have, apparently, a very good case of the production of definite variations of form under the influence of external conditions.

A further study of the results, however, brought out some facts which diminish the value of these observations for our present purposes. It was shown that *A. salina* resembled an immature form of Branchipus, while *A. muhlhausenii* represents a stage which is passed over in the immature life of both Branchipus and *A. salina*. In other words, the effect of the salinity of the water was not to produce definite variations of the body form, but to produce an acceleration of the maturity of the reproductive elements, so that in the water of the greatest degree of saltness the animals became mature, while the body form was still in a larval condition.

A few cases have, however, come under my observation which have bearing on the subject. Among the Isopod crustacea of our coast is a form, Jæra, which presents a great variety of coloration; all the variations may however, be reduced to two types, one in which the coloration is uniformly distributed, and the other in which the pigment is arranged in transverse bands. Within these limits the variations are innumerable, but still the variations may be considered definite. A similar variability within definite limits has been described in another Isopod. In certain sea anemones, as well as in certain caterpillars, the color appeared to be due to environment purely.

Comparison of processes of variation to vicarious substitutions which occur in the more complicated silicates of the mineral world was made. The number of substitutions is limited, but within these limits the amount of variation is practically indefinite, if not infinite.

VERTEBRATED ANIMALS.—Professor Allen next spoke on "Variations in Vertebrated Animals. He confined his paper to variations

which occur in mammals and birds, as those which occur in the lower forms—reptiles and fishes—are less well known. He said that a rather wide range of individual variation is recognized as inherent in all animals. These variations, however, are usually confined within rather narrow constant limits, any considerable excess beyond the normal range coming into the category of sports and are popularly termed fortuitous. A step further gives malformations and monstrosities. Such extreme departures from the normal, while more rare, are probably no more fortuitous than those less marked. The only difference was that the immediate cause was hard to discover.

He illustrated this point by a number of examples, in which changes were plainly due to geographical and climatic forces. As a result biologists had accepted certain generalizations which might be stated as follows:

First. Baird's law of geographical variation in size, which, announced in 1865, still held its own. It asserted that there was a constant increase in the size of individuals of the same species from the south northward, and from the lowlands toward the higher elevations.

Second. The frequent increase in size of peripheral parts, as the tail, beak and claws of birds, took place from the north southward or inversely to the increase and general size.

Third. A general deepening of the coloration took place from the north southward in North America, east of the plains, together with a reduction of white markings and white areas, and a corresponding increase of dark markings and dark areas and a gradual increase in the intensity of iridescent tints in species thus marked.

Fourth. The loss of color over the interior in both mammals and birds having a continental distribution is marked.

Fifth. There is an extreme intensification of color over the heavy rainfall district of the Northwest coast.

The failure of verification of the first law led to its modification to the following formulæ, first published in 1876, which has stood the test of subsequent investigation:

First. The maximum physical development of the individual is attained where the conditions of environment are most favorable to the life of the species.

Second. The largest species of a group (genus, sub-family or family, as the case might be) are found where the group to which they severally belong reaches its highest development, or where it has what may be termed its centre of distribution.

Third. The most typical or most generalized representatives of a group are found also near its centre of distribution, outlying forms being generally more or less aberrant or specialized.

Many examples from animal and bird life were adduced, the most striking being that of the family of hares, which inhabits the whole of the United States. In conclusion the Professor said:

"While climatic variations are obviously definite, and while the direct action of external conditions exerts a powerful influence in moulding at least the superficial characters, these alone go but a little way toward accounting for the profounder modifications that distinguish the higher groups. For example, it is impossible to conceive that any amount of climatic variations could transform a song sparrow or a robin into a woodpecker or the reverse; in fact, make a woodpecker out of any other form of bird. Here functional evolution—change in habits, use or disuse of parts—must come strongly into play, and, to a less degree, food, isolation, interbreeding the struggle for existence, etc. The modification of organs, as the bill, the wings and tail, in birds, is, in my opinion, the result of definite variation, due to a variety of causes—never to fortuitous variation.

"The use to which an organ is put and its structure have evidently the relation of cause and effect. Modification of structure follow and are produced by change of habit. * * * As already intimated, my own studies have given no evidence of evolution through fortuitous variation; the evidence is all in the other direction. I cannot even conceive of the evolution of a new form through an accidental variation, since the individual in which it appears must necessarily pair with a normal individual, and can thus transmit the new variation only in a lessened degree to its offspring, to be again diluted in the next generation through precisely similar contingencies, and so on until the original deviation is obliterated."

Fossil Vertebrata.—Professor Cope spoke on the subject from his standpoint.

He discussed the evidence as to the nature of variation as presented by the extinct vertebrata. He remarked that one difficulty attends this branch of the subject in the circumstance that we do not generally possess enough perfect specimens of any one species of extinct vertebrate to make sure of what its variations may have been. Thus it is that in this case we cannot prove that many variations may have existed of a more or less promiscuous character; but it nevertheless remains that the branch of the subject shows that variation has also

been direct. It is only necessary to call attention to the leading facts, now well known, thanks largely to the investigations of Americans, of the evolution of the vertebrate skeleton.

He commenced with the highest class, the mammalia, where the evidence is very complete. Such is the simple fact of numerical digital reduction from five in the lower ungulates through the numbers four and three to one, as in the horse; or to four and two, as in the ox and deer. Then carrying the line of variation towards the central parts of the skeleton, Professor Cope described the articulation of the limbs. The development of keels on the metacarpals was mentioned; then the development of facets on the radius at the wrist. Next, the development of the tongue and groove articulation between the radius and ulna proximally, and next the same in the humerus and radius at the elbow. The successive reduction of the ulna was mentioned. The hind limb was next considered, and the progressive process of development was described. The intervertebral articulations were then discussed, and their successive modifications in the artiodactyla described.

These characters all indicate a direct variation of individuals in the direction of perfect mechanical contrivances in the skeleton.

Professor Cope then referred to the presence of the same phenomenon in the dentition of mammalia. He dwelt especially on the evolution of the sectorial teeth of carnivorous forms, from the tritubercular upper molar and tuberculosectorial inferior molar.

The successive variations seen in the reptilian skeleton were then referred to. The development of fins from ambulatory limbs in the Ichthyosauria; next of upright walking types, like the birds, in the Dinosauria, with the pelvic bones thrown back to sustain the weight of the viscera in the same position. Next the evolution of the modern types of lizards and snakes by the development in the length of the suspensoria of the lower jaw to enlarge the gape for swallowing; and second, in the loss of the capitular articulations of the ribs, due to the support of the weight on the ground, just as occurs in the Plesiosaurian reptiles and in the whales, where the body is supported by the water.

Professor Cope stated that his conclusion from these and many other similar facts was that the origin of such variations had not been promiscuous or fortuitous, but direct, and in consequence of the operation of a definite cause. That cause he believed to be growth energy (of which we know little or nothing), directed by the mechanical relations between the animal and its environment.

He stated that this relation determined the forms of the bones and the muscles which moved them. These determined the general arrangement of the viscera and of the circulatory system which supplies nutrition. Behind all other systems, however, lies the nervous system, the director of motion, and this was serially and successively developed under the influence of use, which developed intelligence out of simple sensibility and memory.

Following Professor Cope's paper there was a lively and protracted discussion upon all, participated in by a majority of the members present. Most of the arguments were favorable to definite variation, though the other branch of the topic had a few supporters. For over an hour the discussion was kept up, becoming more interesting with every new phase or branch of the subject presented.

Those who took part in the discussion were Professors George Macloskie, H. W. Conn, J. A. Ryder, George Baur, C. B. Davenport, J. T. Rothrock, H. F. Osborn, H. P. Bowditch, J. P. McMurrich, J. A. Allen, E. D. Cope, W. P. Wilson, T. H. Morgan, R. P. Bigelow, C. W. Stiles, William Libbey, Jr., E. A. Andrews.

Prof. Macloskie, speaking on the mechanical growth, argued that the place where the bones really grow is not where they rub together but another part. Also, that it is an important thing that the environment may retard growth while the reproductive parts are active, and in this way changes may occur on account of the environment.

Prof. Osborn did not think that the evidence was conclusive, for, taking into consideration all cases of the kind, there are some exceptions to the principle that bear strongly against it.

Two points were made by Prof. Conn. First, on the tendency of aquatic beetle larvæ to assume similar forms, in spite of the wide difference and relations of the adults; and second, that in the discussion nothing had been said about indirect or congenital variations.

Professor McMurrich brought out more fully the points of his paper, showing that all variations which are transmitted must pass through the germ cells; that the egg must carry the variation. Also that there is such a thing as individual variation, which does not need to be transmitted.

The second annual meeting of the **American Morphological Society** was held at the Academy of Natural Sciences, Philadelphia, December 28th and 29th. The attendance was good, and much interest was manifested in the proceedings of the Society. The following are the titles of the papers read: R. P. Bigelow, On the development of sense-organs of the Guinea Corn-blubber (Cassiopea); E. D. Cope, On

the degeneracy of the scapular and pelvic arches in the Lacertilia; E. B. Wilson, The relation between bilateral symmetry and the cleavage of the ovum; H. F. Osborn, The dentition of Palæonictis, Amblyctonus and Oxyænas; J. P. McMurrich, On the early development of the marine Isopod Jæra; G. Baur, On variation in the genus Tropidurus; C. W. Stiles, On *Spiroptera scutata* Müller: H. F. Osborn, The Evolution of the mammalian molars to and from the tritubercular type; H. B. Ward, Some notes on Nectonema.

The officers for the current year are: President, Professor C. O. Whitman; Vice-President, Professor H. F. Osborn; Secretary-Treasurer, Professor J. P. McMurrich; Members, with the preceding, of the Executive Committee, Professors E. L. Mark and T. H. Morgan.

The Indiana Academy of Science held its seventh annual session in the capitol at Indianapolis, December 30 and 31, 1891. The president of this meeting was Prof. O. P. Hay, Butler University, Irvington, Ind. The unusual number of 98 papers were entered, requiring the Academy to meet, except Wednesday morning and night, in two sections; one devoted to Zoology, Botany and Geology, the other to Physics, Mathematics and Chemistry. Wednesday night President Hay delivered the customary address on "The present state of the Theory of Organic Evolution." The officers for next year are as follows:

President, J. L. CAMPBELL, Crawfordsville, Ind.

Vice-Presidents, J. C. ARTHUR, Lafayette, Ind., W. A. NOYES, Terre Haute, Ind.

Secretary, A. W. BUTLER, Brookville, Ind.

Treasurer, C. A. WALDO, Greencastle, Ind.

Auditors, P. S. BAKER, Greencastle, Ind. W. W. Norman, Greencastle, Ind.

Curators:—

Botany, J. M. COULTER,
Ichthyology, C. H. EIGENMANN,
Geology, S. S. GORBY,
Ornithology, A. W. BUTLER,
Herpetology, O. P. HAY.
Entomology, F. M. WEBSTER,
Mammalogy, E. R. QUICK.

The summer meeting of the Academy will be held by invitation of the faculty of Earlham College, at Richmond, Ind., in May next. At the same time and place will be held the meeting of the Mathematical

sections of the State College Association and of the Teachers Association.

The following papers were read:—

Some suggestions to Teachers of Science or Mathematics in High Schools,.....T. C. Van Nuys

Notes on Numerical Radices, ...C. A. Waldo

The Kankakee and pure water for Northwestern Indiana and Chicago,.....J. L. Campbell

Biological Surveys.....John M. Coulter

The distribution of tropical forms in Peninsular Florida, ...L. M. Underwood

Unused Forest Resources. ....Stanley Coulter

Preliminary Notes on the Geology of Dearborn county, Ind. .....A. J. Bigney

Jefferson County Cystidians.....Geo. C. Hubbard

Hudson River fossils of Jefferson county, Ind.....Geo. C. Hubbard

The Upper limit of the Lower Silurian at Madison, Ind. .....Geo. C. Hubbard

Variations in the Dynamical Conditions during the deposit Rock beds at Richmond, Ind., By title .....Joseph Moore

The relation of the Keokuk groups of Montgomery county, with the typical locality.....C. S. Beachler

Comments on the description of species.....C. S. Beachler

On a deposit of Vertebrate fossils in Colorado.....Amos W. Butler

Topographical evidence of a great and sudden diminution of the ancient water supply of the Wabash river, By title..... ....J. T. Campbell

Source of supply to Medial morains probably from the bottom of the Glacial Channel, By title.....J. T. Campbell

Notes on a Kansas species of Buckeye.....W. A. Kellerman

On the occurrence of certain Western Plants, near Columbus, Ohio..... .....Aug. D. Selby

Preliminary notes on the genus of Hoffmanseggia.....E. M. Fisher

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The Second Annual Meeting of the Nebraska Academy of Sciences, was held at the University of Nebraska, commencing Thursday, December 31, 1891. The following papers were read: The President's Address: Specialization in Science. (Dr. Kingsley being absent, the address was read by Dr. C. E. Bessey). The Slime Moulds of Crete, A. T. Bell; The Evolution of Oxygen by Plants, A. F. Woods; Additions to the Flora of Nebraska, Prof. G. D. Swezey; The Flora of the Black Hills. Dr. C. E. Bessey; Metabolism, Dr. H. B. Lowry; A Bacterial Disease of Corn, H. B. Duncanson; Notes on the Flora of the Artesian Well at Lincoln, J. R. Schofield. The officers for '92 are: President, Dr. Charles E. Bessey, Uni. Nebr., Lincoln; Vice-President, Prof. G. D. Swezey, Doane College, Crete; Secretary, W. Edgar Taylor, State Normal School, Peru; Custodian, Lawrence Bruner, Uni. Nebr., Lincoln; Trustees, E. T. Hartley, Lincoln and Dr. H. B. Lowry, Lincoln. W. E. TAYLOR, Sec'y.

Iowa Academy of Sciences.—The sixth annual session was held December 29, 30, 1891 at Des Moines, Iowa. The following papers were read:

Prof. C. C. Nutting—Address, "Systematic Zoology in Colleges."

Miss Minnie Howe—"Some Experiments for the Purpose of Determining the Active Principles of Bread Making."

J. E. Todd—"Striation of Rocks by River Ice." "Further Notes on the Great Central Plain of the Mississippi."

L. H. Pammel—"Bacteria of Milks," with exhibitions of cultures. "Report of Committee on State Flora." "Phœnological Notes." "Experiments in Prevention of Corn Smut."

Dr. W. B. Niles—"The Action of Disinfectants on Nutrient Media."

Herbert Osborn—"The Orthopterous Fauna of Iowa." "Notes on Certain Iowa Diptera."

F. M. Witter—"Notice of an Arrow Point from the Lœss in the City of Muscatine." "The Gas Wells near Letts, Iowa."

G. E. Patrick—"Can Fat be Fed into Milk? i. e. Can the Composition of Milk be Modified by Variations in the Kind of Food?" "Sugar Beets in Iowa."

R. E. Call—"An Abnormal Hyoid Bone in the Human Subject," with exhibition of specimen.

Herbert Osborn and H. A. Gossard—"Notes on Life History of Agallia sanguinolenta."

Charles R. Keyes—"Geological Structure and Relations of the Coal-Bearing Strata of Central Iowa." Brick and Other Clays of Des Moines." "Aluminum in Iowa."

Prof. E. Haworth—(1) "Melanite from Missouri." (2) "Limonite pseudomorphous after Calcite." (3) "Prismatic Sandstone from Madison County, Missouri."

Prof. H. L. Bruner—"Aboriginal Rock Mortar."

Prof. J. L. Tilton—"A Three Legged Snowbird."

Prof. Calvin—"Distinctions between Acervularia davidsonii and A. profunda."

Prof. S. E. Meek—"Fish Fauna of Arkansas and Iowa compared."

Prof. T. H. McBride—"Slime Moulds of Iowa."

Prof. R. E. Call—"The present Status of Artesian Well investigation in Iowa."

Prof. C. C. Nutting—"Report of Committee on State Fauna."

The following Officers for 1892 were elected.

President, C. C. Nutting, Iowa City. First Vice President, L. H. Pammel, Ames. Second Vice President, E. Haworth, Oskaloosa. Secretary and Treasurer, Herbert Osborn, Ames. Executive Council, The Officers, and J. E. Todd, Tabor, F. M. Witter, Muscatine, R. E. Call, Des Moines.

Natural Science Association of Staten Island.—*October 10th*, 1891.—Informal meeting.

The following paper, by Mr. Chas. W. Leng, was read:

Notes of the tribe Hispini. The habits of certain species of Chrysomelidæ, members of the tribe Hispini, were first made known by Dr. Harris in the year 1835, in the Boston Journal of Natural History (vol. I. pp. 141–147) and were restated in his "Insects Injurious to Vegetation" (p. 120). These species are:

Microrhopala vittata Fab., living on Golden Rod. *Odontota rubra* Web., living on Apple, etc. *Odontota dorsalis* Thunb. living on Locust. They all occur in this neighborhood as do several other species belonging to the tribe, but according to Mr. Wm. Beutenmüller's "Catalogue of Transformations" (Journ. N. Y. Micros. Soc. VII. pp. 1–52) no further record has been made of their habits.

I am now able to add some notes on our Staten Island species and especially on the larvæ of *Odontota scapularis* Oliv.

Frequently in the woods, there grows freely a trailing vine of the Pulse family, identified for me by Mr. W. T. Davis as *Phaseolus helvolus* (or in the last edition of Gray's Manual *Strophostylus pedunculari*s Ell.) Its leaves are often marred by white blotches, the parts affected consisting only of the colorless epidermis of the leaf, its substance having been devoured by the larva of the *Odontota*. In early June the beetles are found upon these plants in copulation or perhaps the female in the act of ovipositing. The eggs are irregular, rough, black masses, about one millimeter in diameter and are attached to the under side of the leaf, usually singly. The larvæ are oblong, flattened, somewhat cuneiform in outline, soft and of a whitish color except the head which is piceous and corneous. They are, of course, minute when first hatched, but continue to grow larger, always living within the leaf and enlarging the white blotch as they eat, until by September they have attained a length of one-fourth inch. The pupal stage is probably of short duration. The beetle is black, roughly sculptured, and has the humeral angles reddish. It is, from an ignorance of its habits perhaps, accounted rare by some collectors, but in the woods of Middletown and in Britton's woods, where its food plant grows freely, it is during June one of the abundant insects, and late in the summer still occurs.

Microrhopala vittata, living on Golden Rod, oviposits and perfects its transformation earlier than the *Odontata* and frequently three or four larvæ inhabit the same leaf. *Solidago canadensis* is especially

favored by this beetle and early in August the lower leaves will be found browned and entirely eaten, and in the pocket formed by the separation of their two surfaces after the larvæ have eaten away the interior are the freshly hatched beetles. From that date the second brood lives on the plants and eats the leaves into sieve-like forms, and now in October, the tops also appear to be attacked. They are closely imbricated and the beetles are nestling in the narrow crevices.

Several other species of the tribe live on Staten Island, but I am yet ignorant of their food plants.

Mr. Arthur Hollick called attention to the gratifying manner in which the law relating to the protection of song birds was being enforced in the country. During the past two weeks at least three gunners had been arrested and heavily fined. On October 1st, one Gustav Merle, of New York, was arrested and fined $140 by Justice Augustus Acker. He was caught with twenty-three dead birds in his possession, which Mr. Hollick assisted in identifying as follows: 8 high-holders (*Colaptes auratus*), 2 yellow-bellied wood-peckers (*Sphyrapicus varius*), 9 hermit thrushes (*Turdus pallasii*), 3 cat birds (*Mimus carolinensis*), and 1 titmouse (*Parus atricapillus*).

December 12*th*, 1891.—Informal meeting.

Mr. L. P. Gratacap, showed a thin section of the coarse trap rock from Lambert's Lane, mentioned in the proceedings of June 13, 1891, and read the following further memorandum in connection with it:

This coarse trap, previously alluded to as possibly containing hypersthene has been since examined microscopically and found to be a true diorite, made up of hornblende, plagioclase, feldspar and quartz, with traces of serpentization, due to alteration. It does not contain hypersthene. In hand specimens it is markedly different from the usual fine grained, compact trap from the Graniteville quarries and would not form as good a stone for road making and other economic uses as does the latter.

Mr. Gratacap also presented the following views in regard to the trap dike and its possible influence on the water supply of the region:

The trap dike on our island, which expands into a widened area at the Elm Park quarry, passes from that point south-westerly in a narrowed ridge, scarcely observable beneath the mantle of drift which covers it until at Graniteville it again is distended into a dome-like nucleus, which extends to the east-ward to the Church road, at Krumm's tavern, where the trap rock is only some seven feet or less below the surface. From this point it sinks and is found again on the

surface south of Lambert's Lane, where the road ascends its somewhat steeply sloping sides. Now the question seems an interesting one whether the springs on the north-west side of the trap ridge may not be regarded as flowing from heads of water in New Jersey, as the trap dike would seem to preclude the derivation of their supply from the water shed of the hilly parts of the Island. The low flat lands enclosed in the curved arm of the trap, which, as is well known, stretches out into Long Neck, is mainly a sandy region and I think does not possess the arrangement of impervious drift clay and water-bearing gravels noticeable in our water-bearing district. Just a few rods from Graniteville, on the Old Place road, there rises a spring which seems to come up on the eastern wall of the trap, and at Lambert's Lane, where the coarse trap rock crops out on the surface, a spring comes up on the west side of the trap. Do these two springs acquire the hydrostatic pressure which makes them spring from different quarters, and in each case is the wall of trap the cause of their rising where they do? Furthermore the ridge south of Long Neck, and separated from the latter by a shallow hollow, up which an arm of the Fresh Kills extends, so exactly imitates the low, rounded and long dome-like back of Long Neck itself and so suggests that there is a bifurcation of the trap ridge, or a parallel vent at this point, and if so the wells of the Crystal Water Works, at the end of this ridge, are also separated from the water shed of the Island by a trap wall and may represent a water source situated in New Jersey. Springs are found on either side of this suppositional second (?) trap flow and it may form a deep-seated barrier between two different areas of water drainage, the area north and west of it belonging to New Jersey, the area south or east of it probably insular.

Mr. Arthur Hollick called attention to the fact that in a paper entitled "A Few Words About Our Water Supply," published in the Staten Island Magazine for August 1888, the relation of the trap dike to the water supply was commented upon in the following words: "I can well remember the mystery which was supposed to be inseparable from the source of the springs [east of the trap ridge] * * * * some persons even went as far as the Orange Mountains in New Jersey to account for them, utterly ignoring the fact that the immense trap dike, which begins at the Palisades, forms Bergen Neck, crosses the Kills and extends through our Island from Port Richmond to Linoleumville, entirely cuts them off from this source."

Mr. Hollick remarked that it was a matter of considerable interest to find that two observers had arrived independently at practically

the same conclusions in regard to the trap dike as a barrier between different water sheds.

Pieces of a drift bowlder of Lower Helderberg limestone, found at Arrochar, was shown by Mr. Gratacap, in which the following fossils were identified: *Meristina arcuata* Hall; *Spirifera macropleura* Conrad; *Strophodonta beckii* Hall; *Strophomena rhomboidalis* Wahl; *Orthis subcarinata* Hall; *Eatonia medialis* Vanuxem; *Cœlaspira concava* Hall; *C. imbricata* Hall; and *Gosselettia mytilimera* Conrad. The last five not previously reported from the Island. Also portions of a similar bowlder from the shore of Tottenville, containing *Tentaculites gyracanthus* Eaton, and *Fistulipora?* sp.?, both new to the Island.

A note from Mr. Ira K. Morris was read, in which he stated that the sketch of old Richmond County Hall, from which was prepared the cut printed in the proceedings of September 12th, 1891, was made in September 1890. The building has since been entirely torn down.

SCIENTIFIC NEWS.

—Dr. Wilhelm Karl von Nageli, the late keeper of the Botanical Museum and Garden in Munich, who died recently in his seventy-fourth year, was a Swiss by birth. He was for some years Professor of Botany at the University of Zurich, but in 1857 was invited by King Maximilian II to the post which he so long occupied. He was a many-sided man, a great mathematician and microscopist, as he showed in his *Das Mikroskop.* His contributions to Alpine botany are numerous. The post darwinian form of the doctrine of Evolution found an energetic opponent in Nageli. The Swiss papers give a long list of his works. His study throughout life, as he said, was to understand the " very least of the very little."

—C. W. Stiles has been elected to the Societe de Biologie (Paris) to the vacancy caused by the death of Prof. Leidy (Membre correspondant etranger).

—The company quarrying limestone on Kelley Island, Lake Erie, has presented to the Western Reserve Historical Society of Cleveland, a portion of the remarkable glacial grooves at that locality. Prof. G. F. Wright of Oberlin writes to the *Cleveland Leader* as follows:

The direction of these grooves is a little south of west, corresponding to that of the axis of the lake. This is nearly at right angles to the

course of the ice scratches on the summit of the watershed south of this, between the lake and the Ohio River. The reason for this change of direction can readily be seen by a little attention to the physical geography. The high lands to the south of the lake rise about seven hundred feet above it. When the ice period was at its climax, and overran these high lands, it took its natural course at right angles to the terminal moraine, and flowed south-east, according to the direction indicated by the scratches on the summit. But when the supply of ice was not sufficient to overrun the high lands, the obstruction in front turned the course, and the result was a motion towards Toledo and the Maumee Valley, where, in the vicinity of Fort Wayne, an extensive terminal moraine was formed. The grooves on the islands near Sandusky were produced during that stage in the recession of the great ice-sheet.

The groove preserved is only a small portion of what still exists. But it would be too much to ask to have more given by the company. As it is, the public spirit shown by the directors, gathered from Boston to Duluth, has rarely been equaled by a similar corporation. Quarrying has already proceeded nearly all around this specimen, and soon the monument preserved will be a monument indeed; the groove being left to cap a pedestal about thirty feet high, and conspicuous from every side. About one-half the surface will be cleared of debris, so as to show fifty feet of the length of the groove, while the other half will remain as it is, beneath its protective covering of pebbles, gravel, sand, and mud, which acted as the graving tools in the firm grasp of ice. In this condition it is to be presented to the Western Reserve Historical Society of Cleveland to remain for the admiration and instruction of all future generations. I trust the citizens of the vicinity will appreciate the noble gift enough to occasionally visit the place and receive the deep impressions it is so well calculated to make.

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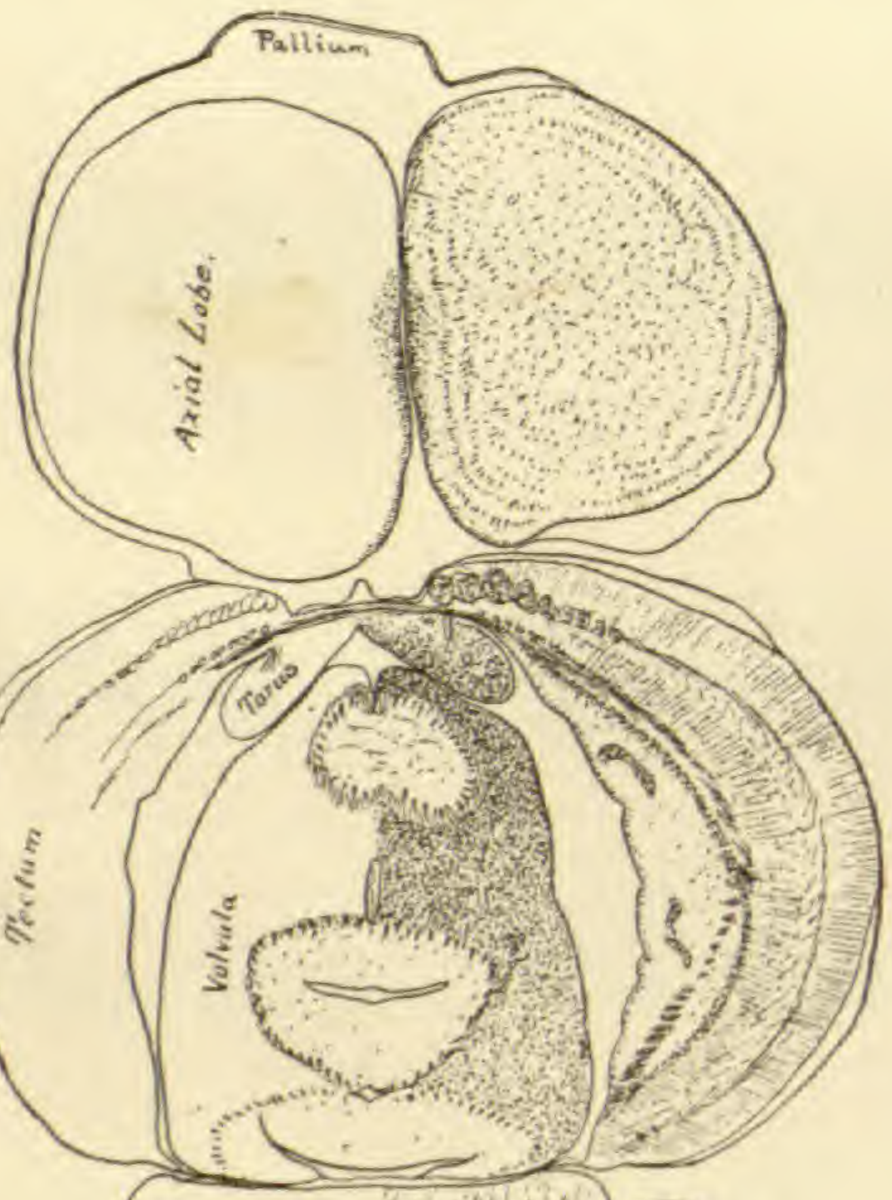

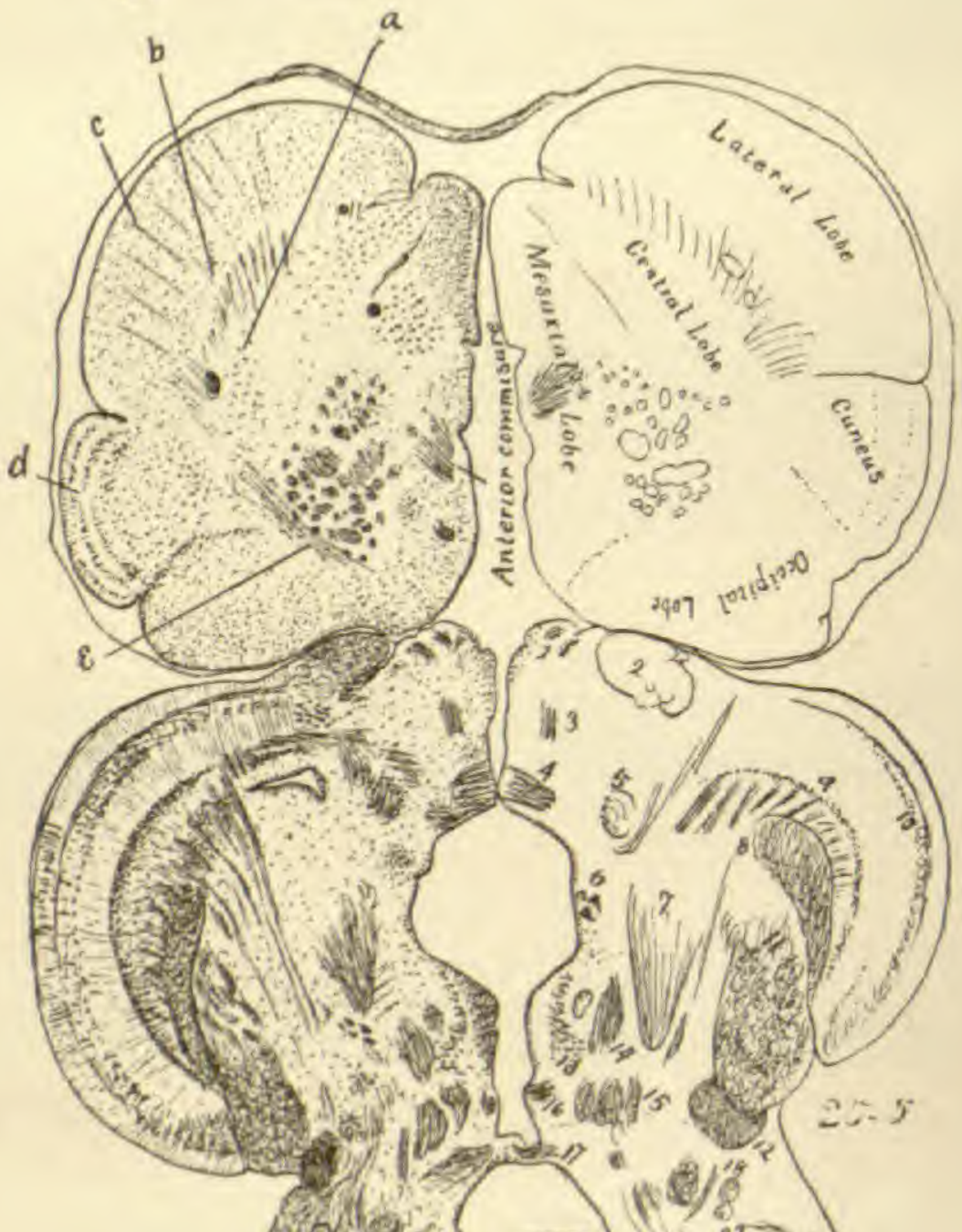

Brain of Haploidonotus.

THE
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PHENOMENA AND DEVELOPMENT OF FECUNDATION.[1]

BY H. J. WEBBER.

NECESSITY OF REPRODUCTION.

The necessity for animals and plants to have some means of reproducing themselves is clearly evident. Every organism has what we may term a normal length of life, which as Weismann has shown, is probably determined by the environment of the species, having been gradually developed by natural selection. If then, after a certain period, organisms die, species would become extinct unless means are provided for their perpetuation.

Of certain organisms, however, we cannot predicate that death will occur. On the contrary, for the Protozoa and probably Protophyta, (unicellular organisms,) it has been determined by investigation that there is no normal length of life and consequently following, death. They are according to Weismann, immortal, so far as normal death is concerned. Nevertheless here also is a necessity for reproduction. Accidental death must be considered and the ravages from higher animals to which the Protozoa and Protophyta are exposed, are enormous. Sothroughout animals and plants, without exception, methods are provided for the reproduction of the species.

[1] A lecture delivered December 16, 1891, before a meeting of the Alumni Association of the St. Louis Medical College.

The first and simplest reproduction is a simple, almost mechanical fission or breaking apart of a naked mass of protoplasm, which is nevertheless an organized being, as seen in the fission of the swarm spores of Myxomycetes, in other Protozoa and Protophyta. The body of the organism, after a lengthened period of growth, reaches a size where the proportion of the surface to the bulk is not sufficient to provide suitable nourishment for its continued growth. Thus a division or multiplication of the body is necessitated to provide greater surface for absorption.

In a thorough consideration of these facts, we come to see how intimately growth and reproduction are associated, growth being nothing more than a protoplasmic and usually cellular reproduction. We are very apt to think of cell division as a necessary accompaniment of growth. But this is not so. Growth is independent of cell multiplication. Cell division need not take place during growth, but may appear only after its conclusion. In *Stypocaulon*, an alga belonging to the Phæosporeæ the lateral branches of the frond, as pointed out by Geyler, attain their full size before the formation of cells begins. Cells are then formed from the base upward, until finally the branch, which was a single cell, becomes a normal multicellular organ. One of the most remarkable cases illustrating this point is found in Caulerpa, a seaweed, the whole vegetative body of which remains throughout life an enormous single cell. (Fig. 1, a portion of frond, natural size). In the cavity of this thick walled vescicle, however, numerous cross bars of cellulose are found to give greater strength. In the common green felt (Vaucheria) even these cross bars are wanting. Cell division, however, usually accompanies growth and as shown above is in most cases a necessity to provide sufficient nutrition.

CELL REPRODUCTION.

The phenomena of cell reproduction or division are so intimately connected with the consideration of all phenomena of reproduction and fecundation that it is necessary for us to briefly consider this subject as a preparatory step. The changes which take place in the cell nucleus seem to be of paramount

importance in cell division. Since Robert Brown, in 1833, first discovered the cell nucleus in the generative organs of orchids, and Von Mohl in 1835 first saw it divide, it has been growing in importance until now, or at least not long ago, the majority of biologists were willing to assign to it all importance in reproduction and in the life of the cell, the cell brain as it were.

Amitosis.—We need only to consider the so called *indirect, mitotic* or *karyokinetic* division. The *direct* or *amitotic* nuclear division it appears from Flemming's[1] late paper and Ziegler's[2] biological discussion of *amitotic* nuclear division, having merely a nutritive or secretory function, occurs in the animal kingdom only at the end of typical cell multiplication, when the cell is given over to other purposes and loses its power of physiological multiplication and reproduction of cells. Amitotic nuclear division then always indicates the end of the series of divisions. Ziegler thinks "it occurs chiefly (perhaps exclusively) in such nuclei as minister to a process of unusually active secretion or assimilation." In typical gland cells it is frequently found. Whether like conclusion will be reached in the vegetable kingdom is yet doubtful, but in the absence of definite investigations we are justified in assuming that similar limitations may be drawn, and that in our consideration of reproduction we need not further discuss this kind of cell division.

Karyokenesis.—In the cell nucleus, two kinds of protoplasm may be distinguished, the *chromatin*, so named from its strong affinity for stains, and the achromatin. Other substances have, it is claimed, been differentiated, but these will for the present answer our purpose. Investigators have come almost uniformly to agree that the essential features of karyokenesis lies in the equal distribution of the chromatin elements to the daughter cells.

The resting nucleus (fig. 2) presents under the microscope a finely punctate character but close examination will show us that these granules (*microsomata*) are connected by fine granu-

[1]W. Flemming, "Ueber Teilung und Kernformen bei Leukocyten und über deren Attraktionssphären." Archiv. f. mikr. Anatomie, 37Bd. 1891.

[2]H. E. Ziegler, "Die biologische Bedeutung der amitotischen (direct) Kernteilung im Tierreich." Biol. Centralblatt, Bd. XI, pp. 372-389, July 1891.

lar threads, and that these, winding up and down here and there in the nucleus, form the so-called reticulum of the nuclear protoplasm. It is in reality then a complexly coiled, possibly continuous thread composing the chromatin matter of the nucleus, coiled in the clear achromatin and surrounded by the nuclear membrane. The first indication of division is an increase in the size of the nucleus. The reticulum gradually contracts until the nucleus, presents a coarsly granular appearance. This contracting continues. The protoplasm begins to collect at the ends of the nucleus which will be the poles of the future nuclear spindle. The contracted chromatin thread becomes apparently homogeneous and finally breaks up into an even number of segments which are distributed in a more or less definite manner at the equator of the nuclear spindle which has made its appearance in the protoplasm during the above changes (figs. 3–4). Each segment now divides into two, splitting longitudinally, making twice the original number, and these, yielding to an apparent attraction from the poles of the dividing nucleus, gradually separate in a definite manner and pull away from the equator toward the poles, following the lines of the delicate nuclear spindle. As they approach their respective poles the daughter segments draw closer and closer together until their upper ends meet and fuse (figs. 5–6). The lower ends then bend inward and also apparently fuse forming a continuous coil (figs. 6–7); while the daughter segments move towards the poles, the spindle fibres remain behind, and others become intercalated and a bulging out occurs, forming ultimately a barrel shaped structure. Soon in the equatorial region slight thickenings form on the spindle fibers (figs. 7–8). These become more and more marked and gradually touch and fuse, forming the new cell-wall between the now divided daughter nuclei (fig. 9).

During the process of cell-wall formation, the segments of the daughter nuclei which have united as above explained, begin to elongate and decrease in thickness, taking on the appearance of the resting nucleus. The remaining steps are just the reverse of those preparatory to division. The filament

elongates and decreases in thickness until it comes again to present the appearance of a resting nucleus.

The above outline of the general course of cell division, in main taken from Strasburger, represents the view of cell division in the vegetable kingdom that has been recognized until very lately.

Karyokinesis in the Animal Cell.—In the division of the animal cell, the phenomena agree in all essential features. We have appearing here the two important bodies occupying the poles of the dividing nucleus, designated first by Fol as "*asters*" later by Van Beneden as "*attractive spheres*" and quite recently by Boveri as "*archoplasmic sphères.*"

The central area of the archoplasm (fig. 10, a.) is situated in the cytoplasm near the nuclear membrane, and from it, as a centre there radiate out in all directions the granular archoplasmic filaments or radiating striae of the asters, some directed toward the nucleus and penetrating into it. The center of the archoplasm is sometimes occupied by a definite body the so-called *centrosome.* The fundamental importance of the function of the archoplasm and its centrosome is yet rather doubtful. Van Beneden looks upon it as a permanent organ, equal in value to the nucleus itself. Guignard, as we shall shortly see, is inclined to assign to it paramount importance in cell division, as directing and guiding the distribution of the chromatin elements.

When we examine a daughter nucleus at the close of karyokinetic division, we see at one side of it the archoplasmic sphere in the position it occupied during the process of division. Shortly before a new division starts (or we may say as the first step in the next division) this archoplasmic sphere divides into two (fig. 11) and the two new archoplasmic spheres thus formed, pass around the nucleus in opposite directions until they come to occupy points on exactly opposite sides, when their effect is soon shown by the starting of the phenomenal changes of karyokinetic division. Thus it is seen as new nuclei arise by division, so also the new archoplasmic spheres arise in in the same manner.

Guignard's[1] *and Wildeman's*[2] *Recent Discoveries.*—It is not until very recently that anything similar to the asters or archoplasm has been discovered in the vegetable cell. This year Guignard, a careful observer, published his observations "On the Existence of Attractive Spheres in the Vegetable Cell" which, from present appearances, marks an epoch in the development of vegetable cytology.

In the resting nucleus, according to Guignard, two *attractive spheres* or *asters* are present. They lie close together at one side of the nucleus, (figs. 49, 54 and 56). Within each is a central corpuscle, the centrosome (figs. 12, a, 49, 54, etc.) surrounded by a transparent areole and around this a granular circle (fig. 12 b.). In general the radiating striae are invisible as long as the cell is in a state of repose (fig. 49). They become feebly apparent when the nucleus presents the first symptoms of entering upon division and at this time they withdraw from each other in order to place themselves at two opposite points corresponding to the poles of the future spindle (figs. 12 and 51). After this the striæ become more evident and direct themselves toward the nucleus, while it is still provided with a nuclear membrane, which confirms the opinion of Strasburger that the spindle originates outside the nucleus in the cytoplasm. When the chromatin segments have separated and collected at the poles, the centrosomes divide in each sphere into two new centrosomes, which thus have their origin at each pole (figs. 53 and 55). They remain in this position till the next nuclear division is preparing to start, when they separate as explained above.

"In resume," says Guignard, "the bodies in question, which merit the name of directive spheres since they govern the division of the nucleus, transmit themselves without discontinuity from one cell to the other throughout the life of the plant."

[1] Leon Guignard, "Sur l'Existence des 'Spheres Attractives' dans les Cellules Vegetales." Compt. Rend. Soc. de Biol. T.iii; p. 182. (March 20, 1891).—Ann. des Sci. Nat. Bot. T. xiv; No's. 3–4; pp. 163–288 (Nov. 1891), (10 pl.). Comptes rendus Acad. des Sci., 9 Mars 1891.

[2] E. De Wildeman, in Bull. Acad. Roy. Sci. Belgique, LXI (1891) pp. 594-602 (1 pl.)

It is interesting to note that very shortly after the appearance of Guignard's paper on attractive spheres, Wildeman (l. c.) published a paper on the same subject containing observations on Spirogyra and several Liverworts and Mosses which is entirely confirmatory of Guignard's discoveries, and Van Tieghem[1] has proposed the term "*directing leucites*" or *tinoleucites* for them, from their property of inciting and directing the binary division of nuclei.

CHARACTER OF THE SEXES.

Geddes and Thompson's Katabolic-Anabolic Theory of Male and Female.—In approaching a consideration of fecundation it is well for us to inquire into the characters of the sexes and as to what determines sex. Let us plunge immediately into a discussion of the theory which seems to us to be the best yet suggested. Geddes and Thompson in their excellent work on the "Evolution of Sex"[2] strongly support what we may term the *katabolic-anabolic* theory of male and female.

In the changes of protoplasm necessitated by the process of living, the upbuilding constructive series of chemical changes are known under the general term *anabolism*; while the disruptive descending series are known under the term *katabolism*. Now male and female differ according to this theory of Geddes and Thompson in their physiological habits; the female being fundamentally of an anabolic character, the male of katabolic character. According to this view males are stronger, handsomer, more active, etc., merely because they are males, that is, are of more active physiological habit,—more metabolic—disruptive changes tending to predominate in the sum of changes in the living matter. The females, on the other hand, live at a profit, are more anabolic,—constructive process predominate in their life; whence indeed their capacity of bearing offspring.

Haeckel in the introduction to his "History of Creation" remarks that the intrinsic value of an hypothesis or theory, depends upon the number of phenomena we can explain by its application. Judging this theory of sex by such a standard,

[1]Van Tieghem, Journ. de Bot. (Morot), V. (1891) pp. 101-102.

[2]Geddes and Thompson, "Evolution of Sex," London 1889.

and we come to realize its great worth, reaching to the very boundaries of sex in its application and being a chief element in the development of sex. Of the very numerous illustrations given by Geddes and Thompson, we can only select a very few.

The female cochineal insect, laden with reserve products spends most of her time on the cactus plant as a mere quiescent gall, while the male, on the contrary, is provided with wings, agile, restless and short lived. Almost innumerable instances of a similar character might be cited. Up to the level of the amphibians the females are generally larger. A sluggish conservative habit of body tends to an increase of size. Lavish expenditure of energy uses up the reverse material and keeps down the size. The large and small spores (macrospores and microspores) which we find in plants, and which mark the beginning of sex, illustrate the same law. Of sex cells in general, all are familiar with the fact that the antherozoids and spermatozoids are always much smaller and infinitely more active than the female cells. The agility of males it appears then is not a special adaptation as Darwin suggested to enable them to better and more surely perform their functions with relation to the other sex, but is a natural characteristic of the constitutional activity of males.

Body temperature which is an index to the pitch of life is distinctly lower in females as observed in the human species, insects and plants.

A familiar and striking illustration of this law is found in the process of menstruation, if it has been rightly interpreted. You are likely, as physicians, more familiar with the various theories of menstruation than I. Probably the most generally accepted one is "that which regards the growth of the mucus coat before fecundation as a preparation for the reception of an ovum if duly fertilized, and the menstruation process itself as the expression of the failure of these preparations." If we express it now in terms of the anabolic-katabolic law, or the anabolic highly vegetative character of the female, menstruation is the means of getting rid of the anabolic surplus in case it is not consumed as intended in the growth and development

of the forming embryo. If fertilization be accomplished we should expect no menstrual flow and so indeed it is,—we have none; the, as it were, parasitic embryo using up the surplus. So also during lactation, while the offspring is still supported by the mother, menstruation does not usually occur, and here also from this theory of sex and of the anabolic female we should not expect it to occur, the surplus being taken up in the support of the offspring. At the close of lactation, menstruation begins again, as we should further expect.

A very different yet similar case is found in the secretion of nectar in flowers. The distinctive anabolic flow continues until fecundation is accomplished, after which it ceases and the surplus passes into the forming seed.

The katabolic-anabolic law seems also to have fundamental importance in determining the sex of a developing embryo. Some experiments conducted by Young, on tadpoles, are very interesting and instructive as bearing on this problem.

Tadpoles pass through a hermaphrodite stage, in common, according to other authors, with most animals. During this phase external influences and especially food decide their fate as regards sex, though hermaphroditism sometimes persists in adult life. When tadpoles were left to themselves, the percentage of females was rather in the majority, the average number being about 57 in a hundred. In the first brood, by feeding with beef, Young raised the percentage of females from 57 to 78: in the second with fish, the percentage raised from 61 to 81; while in the third set when the especially nutritious flesh of frogs was supplied, the percentage rose from 56 to 92. That is to say in the last case, the result of high feeding was that there were 92 females to 8 males. These results coming from such an investigator, emphasizing the anabolic character of the female, are surely very suggestive.

Meehan's observation that old branches of conifers overgrown and shaded by younger ones produce only male inflorescence; and those of various botanists that prothallia of ferns grown in unfavorable conditions produce only antheridia and no archegonia or female organs are further illustrations of the same law and its bearing on the determination of sex.

(To be continued.)

NOTES UPON THE ANATOMY AND HISTOLOGY OF THE PROSENCEPHALON OF TELEOSTS.

By C. L. Herrick.

Our knowledge of the microscopic structure of the cerebrum of bony fishes is very imperfect, and I shall endeavor to show that, notwithstanding the great progress recently made in determining the difficult homologies involved, gross misconceptions pass current at the present time. The fundamental difficulty lies in the fact that the cortex is anatomically absent though morphologically present. In other words, though there is no functionally normal cortex, its place is taken by an epitheligerous membrane which in all important morphological particulars substitutes for it. It is quite a different question whether the cortex is physiologically represented; i. e., whether cellular structures exist which functionally replace the undeveloped cortical areas. This may rank among the most important question of physiology as it undoubtedly is of morphology. Inasmuch as the cortex of higher vertebrates serves solely as the organ of consciousness in the limited sense, if it could be shown that it is not only anatomically absent, but physiologically unrepresented, we should have strong reason to suppose that consciousness is practically absent in the group of fishes and thus is an unnecessary element in a purely animal existence even of a relatively highly differentiated organism.

On the other hand, if it could be shown that some other cell aggregate functions in place of the suppressed cortex, it might be hoped that in locating the substituting areas we should obtain the clue to the origin of the cortex and the law of development or, rather, the archetectonic plan of formation. In the latter respect we have secured so much concurrent evidence from widely different sources that the case seems comparatively clear.

If the fish brain, in spite of its great dissimilarity to the brains of higher vertebrates is actually homologous with the latter in detail, it should be possible to discover the exact

homologies of the separate organs, or determine the absence of certain parts, together with the morphological reasons for their suppression. In this direction nothing was possible before the pallium had been identified with the cortex and the homologies of the ventricles had been determined in conformity therewith. Even since this has been accomplished many homologies remained uncertain which were essential to a proper understanding of the evolution of the brain of higher vertebrates. None of these homologies are more important than those which relate to the commissures which may naturally be taken as the points of reference. In this last mentioned direction a study of the Drum (*Haplodinotus*) has fortunately afforded the necessary clues.

What follows is a brief summary of a detailed paper to appear in the December number of the *Journal of Comparative Neurology*, forming part of a series which has appeared in several previous issues. The methods pursued will be given in full in connection with the paper, so that it is only necessary to say that a modification of the hæmatoxylin process has been hit upon, which serves to sharply differentiate all the histological elements, bringing out the variations in cell-structure beautifully. In fact a fish brain thus treated is histologically, instead of the least satisfactory, rather the most beautiful of brain preparations. A large series of sections has been secured from which a few of the more important data are here noted.

First, in respect to histological differentiation within the cerebrum. If the axial lobe of the fish cerebrum represents functionally the entire brain, as would seem probable unless one claims that the fish leads a purely reflex nervous existence, that there should occur in it the various types of cells which characterize the several regions of the cortex in higher animals. The writer has abundantly shown in a series of publications covering most of the classes of vertebrates that there is a structural difference between the kinesodic and æsthesodic areas of the cortex and that the motor and sensory cells are more distinctly aggregated in lower than in higher vertebrates. In other words, that types of cells, which in higher animals are interblended, are quite distinctly seggregated into definite

areas in lower groups. Thus we have shown that in rodents and marsupials the motor and sensory cells are more distinct and topographically separable than in higher animals, that in reptiles they are much more sharply limited than in mammals and that in fishes the distinction is still sharper. Mr. Turner, who at our suggestion investigated the same question in birds, has found a close resemblance to the reptilian type and fully corroborates the statement that complete structural dissimilarity between kinesodic and æsthesodic cells prevail in the Monocondylia. Whether we regard the brain of a fish as the result of a retrograde metamorphosis from a more typical structure, or as representing a primitive condition, it will be conceded that the cells corresponding to kinesodic and æsthesodic processes must be in all probability represented. The absence of the cortex limits our search to the axial lobe. Observations upon various groups of reptiles have led me on several different occasions to suggest that the axial lobe, seen in those groups where the cortex is present, is a sort of proliferating centre from which cortical cells are formed. [1]

This hypothesis has been further substantiated by the observations of Mr. Turner,[2] upon the axial lobe of various birds. It is also worthy of note that the birds resemble fishes in the great restriction of the cortex and in specific substitutions therefore in the form of niduli within the axial lobe. It would, therefore, appear legitimate to consider the axial lobe as the source from which the cortex has sprung, so far as its histological elements are concerned, a suggestion which is further emphasized by the fact, brought out by Professor His and extended by the writer, that all neural elements are derived from the epithelial structures lining the ventricle.

A corollary of this would be the concentration of all commissures and tracts belonging strictly to the cortex in the axial lobe. The position of such structures might then serve to determine the direction in which the complicated brain of

[1] Notes on the Brain of the Alligator. Journ. Cincinnati Society of Natural History, vol. XII, p. 455; Contributions to the Comparative Morphology of the Central Nervous System, II. Morphology and Histology of the Brain of certain Reptiles, *Journal of Comparative Neurology*, vol. I. p. 21, March 1891.

[2] *Journ. Comp. Neurology. Vol. 1, p. 71.*

higher vertebrates has been folded and differentiated. This principle the writer has employed in the determination of the histogenesis of the cerebellum. (Compare a recent article on the cerebellum in "*Science.*") Now to return to the special subject of our study, the cerebrum of the Drum is moderately large and well differentiated. The pallium is well developed and completely devoid of nerve cells, but the surface of the cerebrum is nevertheless quite conspicuously fissured. It was shown by my brother and myself in a series of articles in the *Journal of Comparative Neurology* for June and October, that the cerebrum of teleosts is more or less constantly marked by fissures which cannot be homologized, except in two cases, with the fissures of higher vertebrates, because of their lying in the surface of the axial lobe rather than the cortex. Nevertheless, these fissures serve to constantly delimit certain areas of the axial lobe, which are also remarkably constant in their histological differentiation. Using these land marks it has proven possible to define a number of distinct lobes, which have received names suggestive of their position. The homologue of the hippocampus, however, is easily recognized, not only by its position, but by reason of the anatomical connections. It forms a raised lip or projection along the ventral surface and is lateral of a fissure perfectly homologous of the rhinalis of higher animals. The forward prolongation may be compared to the convexity in the corresponding region of the pyriform lobe of rodents. Caudad it expands into an obpyriform lobe which is the hippocampus in a restricted sense. Throughout its entire extent, the hippocampal lobe is the part which mediates between the pallium (cortex) and the axial lobe, and is therefore identical in position with the outer part of the hippocampus of mammals. In microscopic structure it differs from the adjacent regions. The radix lateralis, which, as we have shown in the series of articles above referred to, is wholly distinct from the radix mesalis, follows the rhinalis fissure and may be traced in a single horizontal section to the caudo-ventral aspect of the hippocampus, where the fibres spread out upon the surface in a way entirely similar to that observed in rodents. The resemblance to the homologous organ of higher vertebrates does not

cease here, but from the deeper parts of the hippocampal lobe an ental tract, corresponding to the hippocampal commissure and descending fornix tract, arises and passes cephalomesad to cross just caudad of the strongly developed callosum. At this point a branch is given off precisely like the fornix which passes to a bilobed cellular mass, projecting ventrad into the ventricle caudad and dorsal of the lamina terminalis. In appearance and structure, as well as fibrous connections, these tubers can only be regarded as identical with the corpus fornicis. Nothing is wanting to make the homology perfect. Fibres from the fornix body can be traced into the thalamus, but nothing indentifiable with the mammillaries could be made out with certainty.

The radix mesalis of the olfactory is much larger and more distinct, and seems to be derived from a mass of cells occupying the pes, while the radix lateralis springs from the pero. This bundle passes caudo-dorsad and then mesad and crosses in a special ventral portion of the præcommissura quite distinct from the specific homologue of the latter. In the Drum, the olfactories are attached to the cerebrum, or more strictly, to the præthalamus just at the origin of the lamina terminalis. They are obviously not appendages of the prosencephalon, as we have suggested on morphological grounds it would be impossible for them to be, but the radices have suffered division or latero-flexion with the outgrowth of the secondary cerebral vesicles. The origin of the hippocampal loop of the olfactory tract becomes obvious by inspection of an embryonic brain or that of a fish, it being the least diverted portion of the walls of the primitive prosencephalic ventricle carrying with it the tracts and commissural origins proper to it. It is a curious fact that of the two radices of the olfactory, one belongs to the dorsal and the other to the ventral system and the commissural or decussational fibres likewise belong, one to the ventral the other to the dorsal of the two primary commissural systems of the neural tube. The radix lateralis connects, via hippocampus, with the dorsal system associated with the callosum, *i. e.* the fornix and hippocampal commissure. The radix mesalis, on the other hand connects with the anterior commissure sys-

tem. It would thus appear that the olfactory system, including the pes, is homodynamous with a complete neuromere or symmetrical fraction thereof.

The corpus callosum has been so much studied of late that it would be an act of presumption to put forth a new theory without the amplest evidence. In the present case the writer, in presenting an interpretation entirely different from the prevailing one, does so with the perfect confidence that any one who will examine the facts exhibited in our sections will be convinced of the correctness of the view. In a previous paper[1] the writer has indicated the existence of a hitherto unsuspected commissure in *Lepidosteus* and identified it as the homologue of the callosum hippocampal commissure in the following words:

"*Commissures of the Cerebrum.*—The exact equivalence of the commissures of the cerebrum is a matter of much difficulty in these fishes where the whole dorsal and median portion of the tectum cerebri or mantle portion is apparently represented by the pallium cerebri. Considering, however, that the direction in which the cerebrum has been differentiated in higher animals is caudad, and that, in the lower brains, bodies which lie caudad or dorsad in higher vertebrates must be sought dorsad or cephalad, it is not difficult to homologize the pallium with the plexus-bearing projection from the posterior and mesal margin of the mantle. Since the plexus in this case occupies the vertex, instead of projecting from the caudal region, all structures morphologically cephalad of the plexus must be sought still further cephalad or ventrad. Using this clue, and observing that the cerebral cortex folds ventrad over the olfactory structure, we think we find a homologue of the callosohippocampal commissure connecting the two halves of the cerebrum cephalad of the openings of the olfactory crura into the common ventricle, and lying just entad of the membranous lamina terminalis. The bundle is very small and seems to contain a few fibres from the olfactory regions, as well as

[1] Topography and Histology of the Brain of certain Ganoid Fishes, Journ. Comp. Neurology, vol. I., p. 167–168.

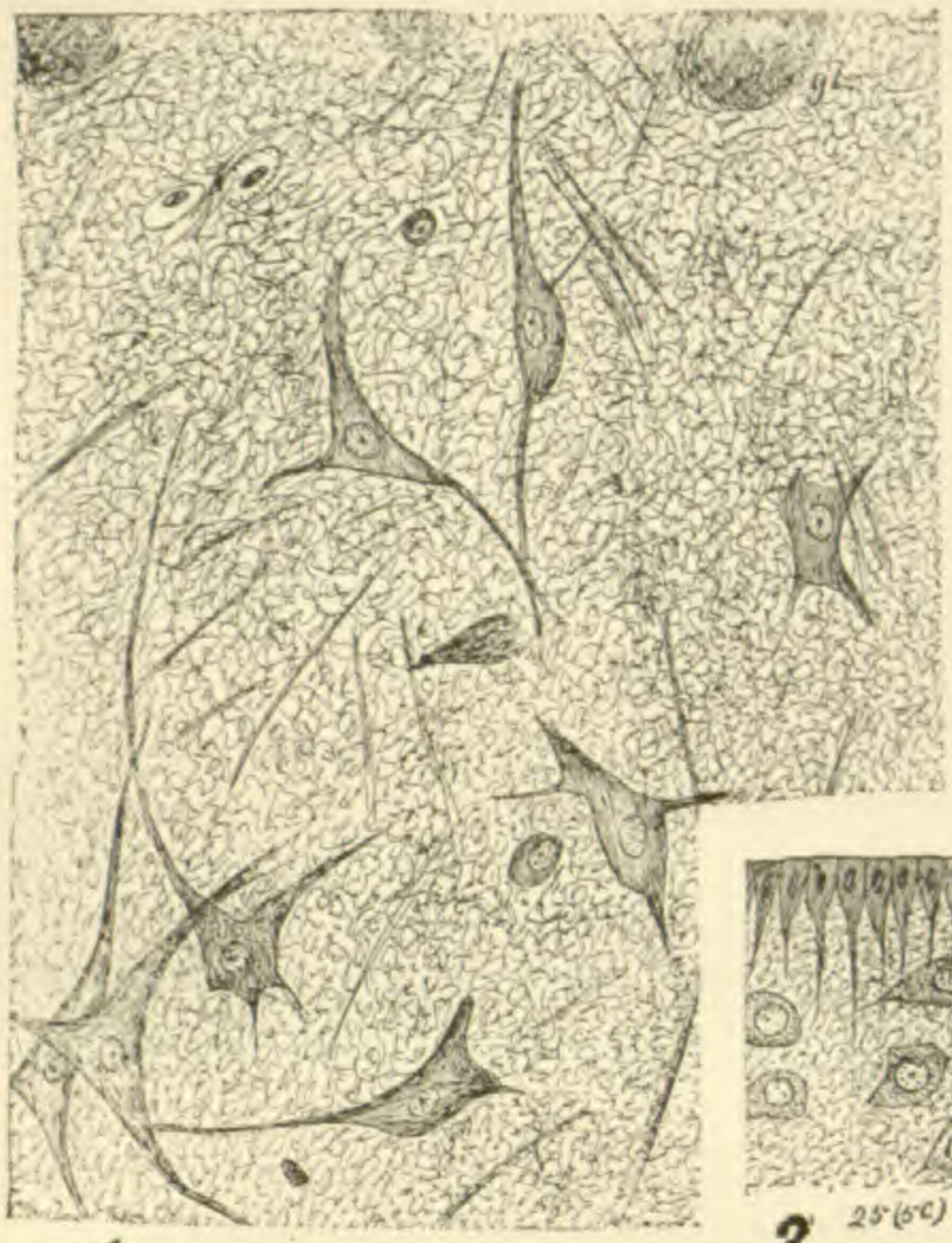
others from the cephalic portions of the cerebrum. No indication of the callosum was seen in Scaphirynchus."

In the Drum, however, the callosum is relatively large and conspicuous. It lies far cephalad and somewhat ventrad (morphologically dorso-cephalad) of the anterior commissure. It is directly associated with a large nidulus of pyramidal cells, which occupies a central position in the axial lobe in the direct line of the pyramid fibres produced. This central lobe is the unmistakable homologue of the motor areas occupying the cephalic cortical regions of higher vertebrates, and is therefore properly associated with the callosum. The callosum lies dorsad of and adjacent to the line where the pallium adheres to the axial lobe. It is therefore just where it would be expected upon the hypothesis that the structures otherwise found in the cortex had been driven from the latter by its conversion into the pallium, or, better, had failed to grow out into the pallium when it was formed.

Remembering that the growth of the cerebrum has been largely dorso-caudad, such a retarding as here supposed would leave the callosum where we find it at the cephalic juncture of pallium and axial lobe. Since the interventricular cortical lobe is suppressed in teleosts, it follows that the callosum and anterior commissure, which are collocated by accident, rather than relationship in Reptilia and Amphibia, are here widely separated. These facts are entirely in agreement with the highly philosophical theory of the commissures proposed by Osborn, though in the present case, Osborn supposed (an opinion in which the writer at first shared) that the callosum of fishes is contained in the anterior commissure group. The considerations above mentioned show that in the absence of the mesal walls of the cortex a collocation the two commissural systems, except by great axial shortening of the brain, would be impossible.

As to the general question, whether it is proper to suppose that the cell structures normally found in the cortex are derived from the axial lobe and may be retained there by conversion of the cortex to a cell-less pallium, I refer, first, to the data of embryology; second, to my own observations upon young

PLATE VIII.



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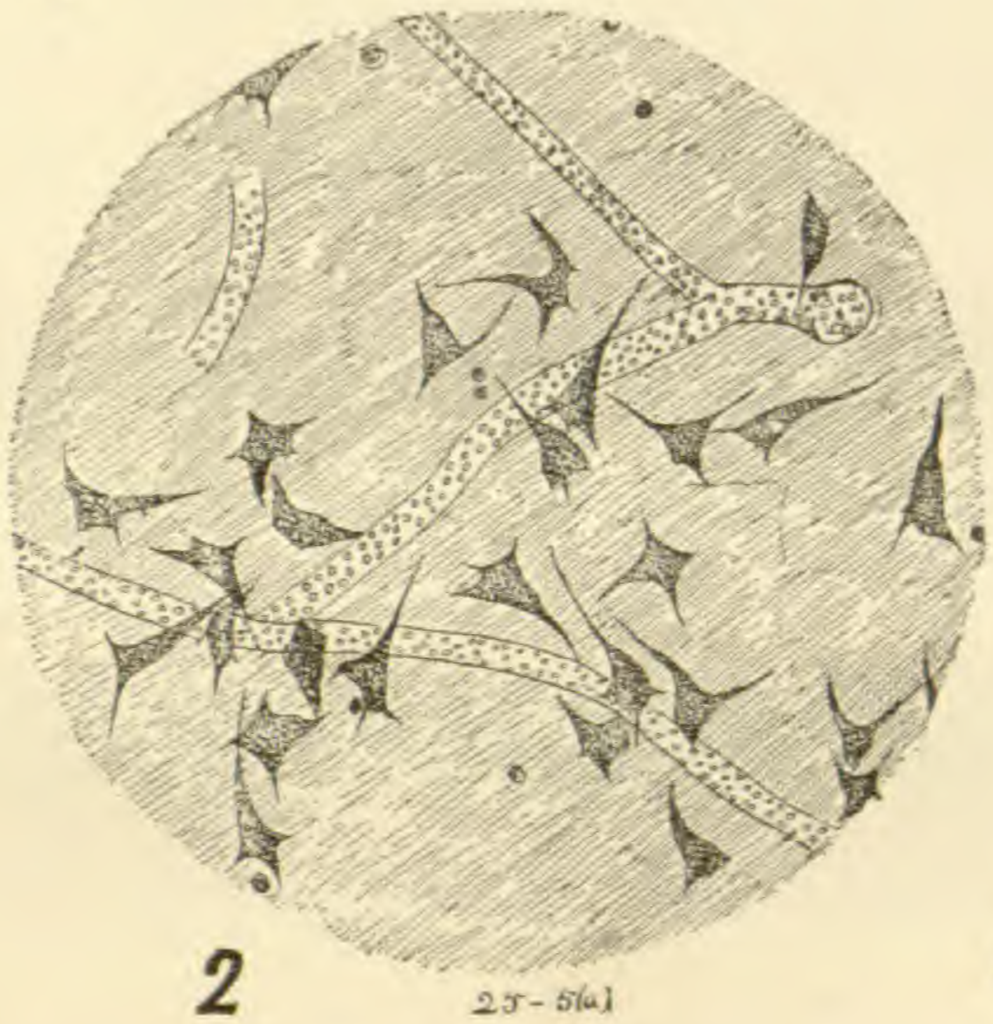

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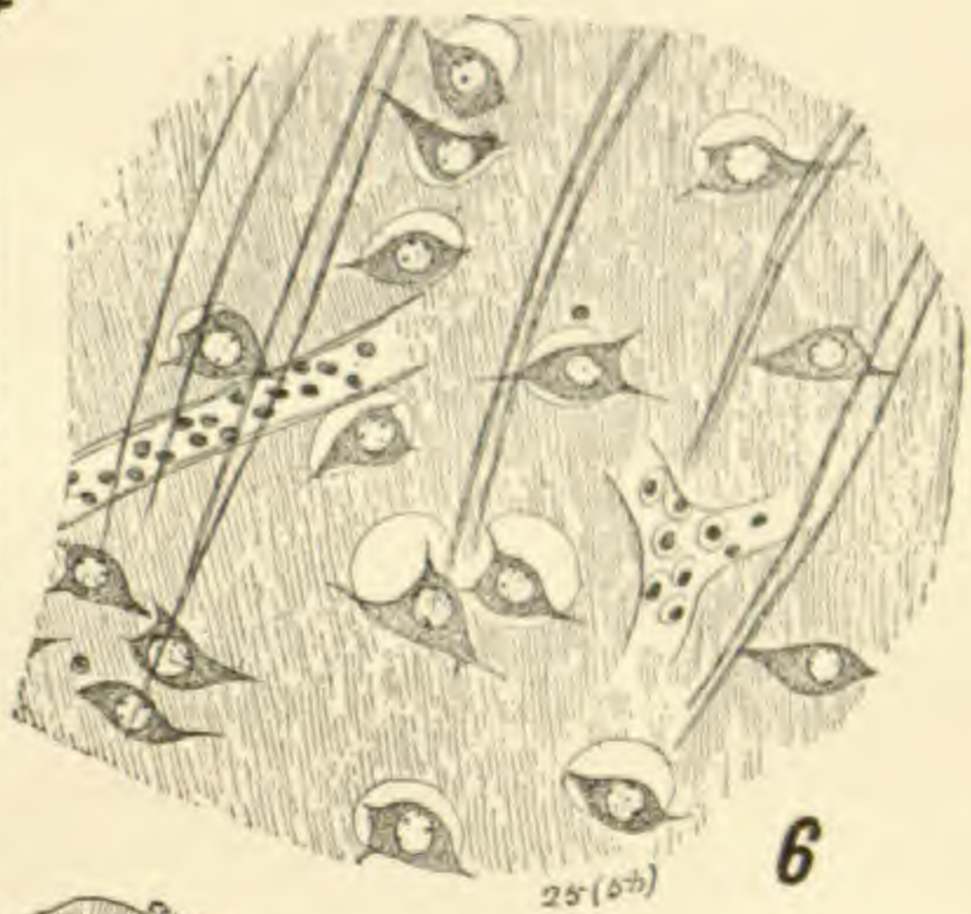

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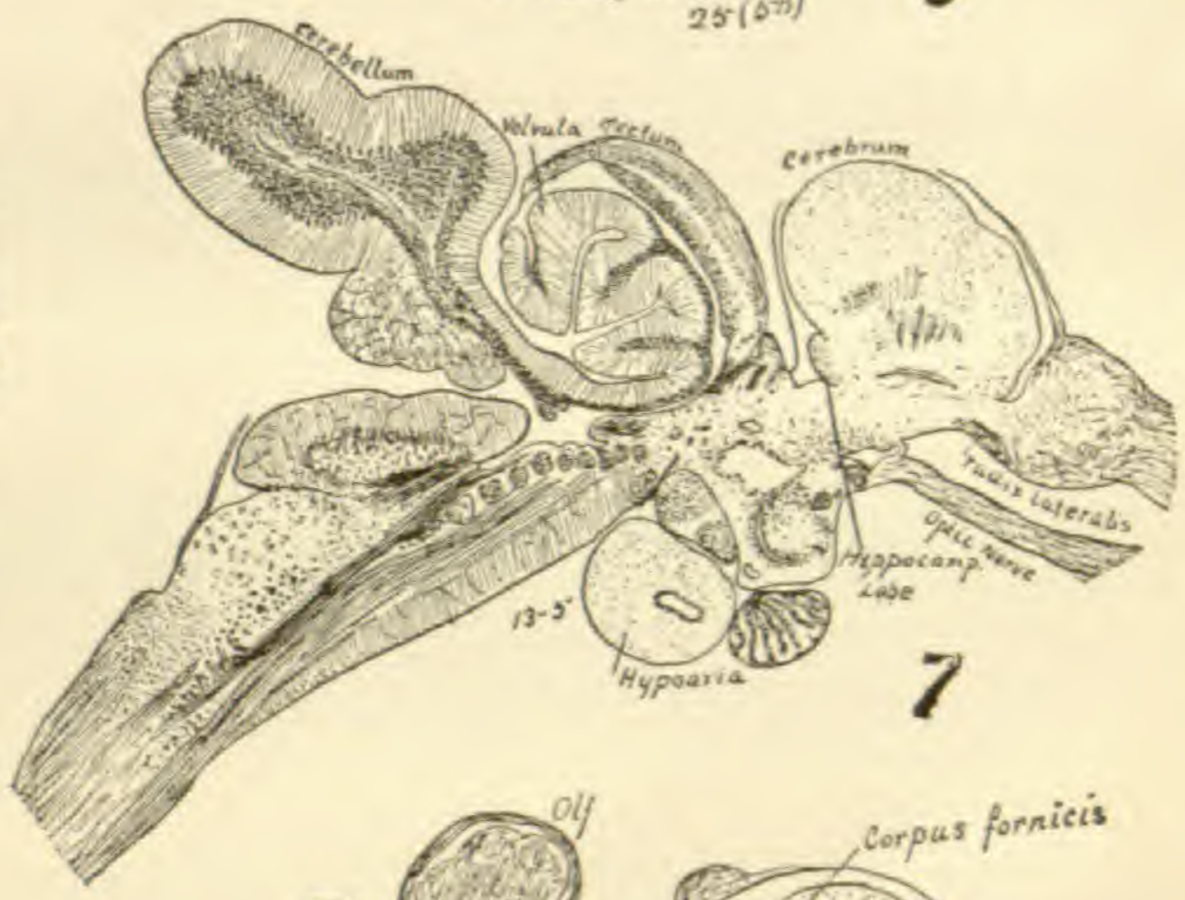

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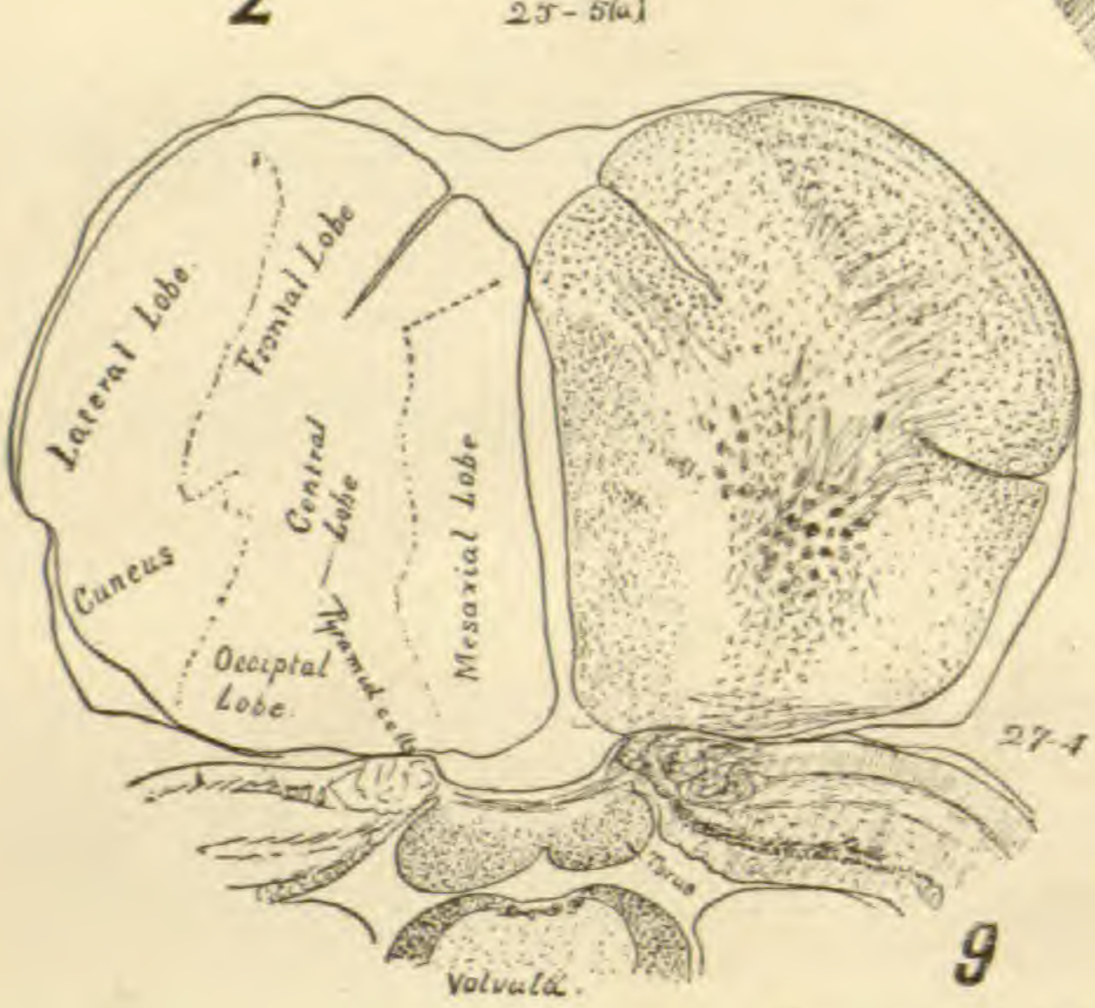

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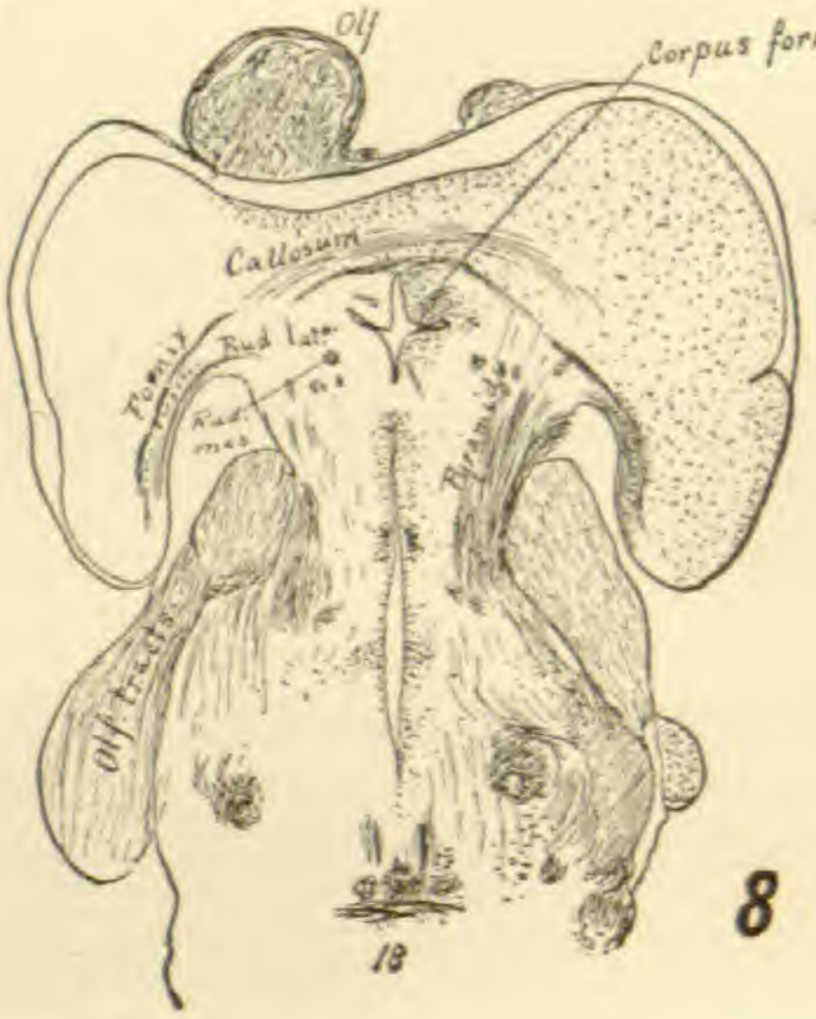

8

Brain of Haploidonotus.

reptilian brains; and, third, to the discovery made by my pupil, Mr. Turner, that in the brain of birds there are several introverted cortical niduli within the axial lobe, in regions where the cortex is restricted or aborted.

In general, then, it seems proper to regard the cerebrum as a product of a dorso-lateral pouch from the thalamus, carrying with it the commissural systems (dorsal and ventral) belonging to what may be called the præthalamic segment or neuromere. The hippocampal system may be regarded as representing a part of the dorsal commissure, the callosum a part of the ventral and perhaps part of the dorsal, while the anterior commissure is decidedly ventral.

At any rate the morphological relations in fishes are precisely as in higher vertebrates. The conclusions above indicated may be thus summarized.

1. Fishes have a distinct corpus callosum separated from and on the opposite side of the ventricle to the præcommissura.

2. Fishes have a distinct fornix and hippocampal commissure.

3. A well-marked fornix body is present in fishes having normal fibre connections.

4. There are distinct radices mesalis and lateralis in the ichthic olfactory lobe, the former crossing in the anterior commissure, the latter passing to a hippocampal lobe.

5. The hippocampus of fishes is a distinct lobe of the axial part of the cerebrum.

6. The axial lobe in fishes is composed not only of the elements proper to the corpus striatum or sauropsidian axial lobe but also contains rudiments of the sensory and motor niduli of the cortex.

7. The two types of cells are sharply differentiated.

EXPLANATION OF PLATES.

Plate VII.

Horizontal longitudinal sections through the entire brain of the drum, *Haplodinotus grunniens*.

Fig. 1. Section through the olfactory lobes and corpus fornicis. The radix lateralis is easily followed throughout its entire length from the lateral aspect of the pero to the hippocampus. The radix mesalis arises in the pes and, curving ventral and then dorsal, appears cephalo-ventrad of the axial commissure as a circular bundle.

Fig. 2. Section at the level of the axial commissure (decussation of the basal peduncular tracts of Edinger) and callosum.

Fig. 3. Section above the level of the præcommissure, the tracts of which are visible in the section.

Fig. 4. Section near the dorsal surface of the cerebrum. The figure illustrates the structure of volvula and cerebellum.

Plate VIII.

Fig. 1. Portion of olfactory pero highly magnified.

Fig. 2. Pyramidal (kinesodic) cells from the central lobe of cerebrum.

Fig. 3. Superficial portion of lateral lobe to show epithelium. The æsthesodic cells are transversely cut.

Fig. 4. Cells from E in fig. 3 of the previous plate.

Fig. 5. Portion of the cuneus.

Fig. 6. Cells from the lateral lobe.

Fig. 7. Longitudinal section through the whole brain.

Fig. 8. Horizonal section through entire brain somewhat dorsad of fig. 3 of the preceding plate.

Fig. 9. Section just dorsad of the olfactory crus to show the relations of fornix tracts and callosum.

ON THE HABITS AND AFFINITIES OF THE NEW AUSTRALIAN MAMMAL, *NOTORYCTES TYPHLOPS*.

By E. D. Cope.

The description of this remarkable mammal by Professor Stirling, of the University of Adelaide, has appeared in the *Transactions of the Royal Society of South Australia*, 1891 (July), p. 154. The announcement of the discovery of this supposed new marsupial by Prof. Stirling in the English journals during the past season has excited much interest, and the full description now given will be carefully read. My own reading has led me to make certain reflections on the characters and affinities of the animal, which are herewith given. But I first copy the following account of its

HABITS

from Professor Stirling's paper:

"It appears that the first specimen was captured by Mr. Wm. Coulthard, manager of the Frew River Station and other Northern runs belonging to the Willowie Pastoral Company. Attracted by some peculiar tracks on reaching his camp one evening on the Finke River, while traversing the Idracowra Station with cattle, he followed them up and found the animal lying under a tussock of spinifex, or porcupine grass (*Triodia irritans*). Though he is an old bush hand, with all the watchful alertness and powers of observation usually acquired by those who live lives of difficulty and danger, this was the first and only specimen of the animal he ever saw. As previously stated, this found its way to the museum through the agency of Messrs. Benham and Molineaux. The three subsequently received shortly afterwards, as well as the last lot recently secured by Mr. Bishop during our journey through the country, were also found on the Idracowra Station. This is a large cattle-run, comprising several hundred square miles of country in the Southern part of the Northern Territory of South Aus-

tralia, which lies immediately to the West of the telegraph line between the Charlotte Waters and Alice Springs Stations. The great dry water-course of the Finke River, which runs from N. W. to S. E., bounds the run for some eighty miles on the North and North East. Its distance from Adelaide is, roughly speaking, a thousand miles. Flats and sandhills of red sand, more or less well covered with spinifex and acacias, constitute a large portion of the country, and the rainfall is inconsiderable. Curiously enough, all the specimens hitherto received by me have been found within a circumscribed area, four miles from the Idracowra Head Station, which is situated on the Finke water-course itself, and almost invariably among the sandhills. I have it, however, on very fair authority, that the animal has been seen on the Undoolya Station, which lies immediately South of the McDonnell Ranges, and that one also was found drowned after heavy rain at Tempe Downs, a station situated about 120 miles W. S. W. of Alice Springs. These points will sufficiently define its range, so far as is known at present. They do not appear to be very numerous. Very few of the white men in the district had ever seen it, even though constantly traveling, and not many of the natives whom I came across recognized the well-executed colored drawing I carried with me. It must be remembered, however, that I did not pass through the exact spot which so far appears to be its focus of distribution. Nor did a very considerable reward which I offered cause any specimens to be forthcoming between the first lot received, over two years ago, and that recently secured during my transcontinental trip. With few exceptions the animals have been captured by the aboriginals, who, with their phenomenal powers of tracking, follow up their traces until they are caught. For this reason they can only be found with certainty after rain, which sets the surface of the sand and enables it to retain tracks that would be immediately obliterated when it is dry and loose. Nor are they found except during warm weather. So that the short period of semi-tropical summer rains appears to be the favorable period for their capture. For this suitable combination of wet and warmth, Mr. Bishop had to wait three months

before he was able to get them, and in all cases they were found during the day time. Perpetual burrowing seems to be the characteristic feature of its life. Both Mr. Bishop and Mr. Benham, who have seen the animal in its native state, report that emerging from the sand it travels on the surface for a few feet, at a slowish pace, with a peculiar sinuous motion, the belly much flattened against the ground while it rests on the outside of its fore-paws, which are thus doubled in under it. It leaves behind it a peculiar sinuous triple track, the outer impressions more or less interrupted, being caused by the feet, and the central continuous line by the tail, which seems to be pressed down in the rear. Constantly on the look-out for its tracks, I was often deceived by those of numerous lizards, which are somewhat similar in these respects. It enters the sand obliquely and travels underground either for a few feet or for many yards, not apparently reaching a depth of more than two or three inches, for whilst underground its progress can often be detected by a slight cracking or moving of the surface over its position. In penetrating the soil, free use as a borer is made of the conical snout with its horny protecting shield, and the powerful scoop-like fore-claws are also early brought into play. As it disappears from sight, the hind limbs as well are used to throw the soil backward, which falls in again behind it as it goes, so that no permanent tunnel is left to mark its course. Again emerging at some distance, it travels for a few feet upon the surface, and then descends as before. I hear nothing of its making or occupying at any time permanent burrows. Both my informants lay great stress on the phenomenal rapidity with which it can burrow, as observed both in a state of nature and in captivity. In some notes sent me by Mr. Benham the following statement appears: 'Almost any of the men here (Idracowra) can tell you how one got away from me in the loose sand. I brought it home alive and began talking about how fast it could burrow, so Mr. Stokes wanted to see it. We took a spade and loosened the top soil near the house, and put it down. I kept my hand close to it until it was nearly out of sight, and then started scratching after it,

but it was too quick; so I took a shovel and began to dig after it, but could not get him.

"'One of the men then came with another shovel, and also a lubra (aboriginal female) who scratched, but the three of us failed to get him.' Making all allowances for possible misdirected energies in this experiment, there is no doubt but that their burrowing powers are remarkable. Mr. Bishop, who knew of my approach, made great efforts to keep alive for me some of those he had captured, and placed them for safe keeping in buckets of sand, but in spite of all care and attention one only lived as long as four days. Night and day the sound of their ceaseless burrowing was to be heard. Acting on my advice, previously given, in consequence of an examination of the contents of the intestines of one of the earlier specimens, he supplied them with ants as food, but they ate none. They did, however, eat one 'witchety,' the native name of large white grubs, much relished by the blacks as an article of food, which are the larval forms of certain Longicorn beetles and Lepidoptera, and Mr. Benham informed me that one of his ate a piece of bread on one occasion, but it only lived a day. They thus appear to stand captivity very badly. On being handled they make no attempt to bite. No black fellow that I questioned had even seen the young, nor did they know any thing whatever of any nests or breeding places used by them. Their native name is 'oor-quamata,' the terminal 'r' of the first syllable being much rolled so as almost to convey the sound of an interpolated short 'i' between the 'r' and the 'q'; the accentuated syllable is strongly marked, the vowels having the same value as in 'quarrel.' Mr. Benham states that the natives have a superstitious dread of them, and applied to one the term 'kudoicka' which they translate as 'devil-devil;' but I could not get this confirmed by any of the blacks I saw. In fact the natives seem to know very little about them, and could give me no information whatever as to what their food was, or whether they got it above or under ground. With the material at my disposal I should be able definitely to settle this point, and indeed, in one of my first specimens, I did most certainly find the remains of ants and

some other insect debris in what remained of the intestines; but as the Editor of these Transactions urgently calls for the completion of this paper, I am reluctantly obliged to postpone to a future issue the result of further investigation on this and on other points." (Trans. Roy. Soc. South Australia, vol. xiv, Pt. I, 1891. p. 155).

Affinities.

The most superficial observer will be at once struck with the remarkable resemblance which evidently subsists between the genus Notoryctes and the Chrysochlorid Insectivora of South Africa. The question then presents itself, is this a case of adaptive resemblance, or is it an example of true affinity? The question to be decided early in the investigation is whether Notoryctes is truly a marsupial.

The evidence furnished by Prof. Stirling that this animal is marsupial, consists of the following characters. First; it has a posteriorly opening marsupial pouch. Second; it has two very small osseous nodules in the tendon of the external oblique muscles, close to their insertion on the anterior border of the pubic symphysis (p. 178). They are scarcely visible without a lens, and are consequently liable to be overlooked. Third; the angle of the lower jaw is inflected. On these characters it may be remarked; First; that the pouch contains no mammæ as in Marsupialia, indicating that the early parturition of that order does not exist. Second; that a fibro-cartilage connects the external oblique muscle with the pubis in Canis, which Huxley, (Anatomy of Vert. Animals, p. 355) says "appears to represent the marsupial bone or cartilage of the marsupials." Third; that the inflection of the angle of the mandible is not greater, (to judge from Prof. Stirling's figures), than that seen in some Glires (Haplodontia) and Insectivora. In fact, this region is much like that seen in the species of Chrysochloris, where the angle is produced and incurved.

In opposition to the view that Notoryctes is a marsupial may be cited the two objections just made to the first and second of the characters adduced by Stirling, which might however be overcome, if stronger marsupial characters could

be found in the brain and reproductive system. The brain has not been examined, but the external form of the skull indicates characters like those of Chrysochloris, including larger hemispheres than are usual in marsupials. As to the reproductive system, the penis is single, indicating an undivided vagina in the female, a character non-marsupial, or present only in a highly specialized family of the order. The penis is cloacal as it is in Chrysochloris, as described by Dobson (Monograph of the Insectivora p. 125). Returning to the skeleton, we have other Insectivorous characters, which are non-marsupial. First; the imperforate palate; Second; the presence of a patella; Third; the incisor teeth, which are neither diprotodont, nor polyprotodont, but in number $\frac{3}{3}$, normal in the placental Mammalia.

If we adopt the view that this genus is placental, we have the following additional points of resemblance to the Chrysochloridæ. First, the general shape and structure of the skull. Second, the shape of the scapula, where the inferior (posterior) spinous ridge represents the edge of the thickened border in Chrysochloris. Third, the presence of a heavy metacromion. Fourth, the slenderness of the clavicle. Fifth, the shape of the humerus, especially distally, where however the entepicondylar foramen is closed, while it is open in Chrysochloris (Dobson). Sixth, the shapes of the ulna and radius are much like those in Chrysochloris. Seventh, even the form and character of the anterior foot, where the resemblance is great, although obvious differences exist. Eighth, the general shape of the pelvis is similar, especially the horizontal position, with minute obturator foramen. The presence of a symphysis pubis, and a posterior articulation of the ischium with the sacrum are important differences. The symphysis exists however in various Insectivora and the ischiosacral articulation is present in many Edentata. There is not much resemblance in the forms of the tibia and fibula, but these two elements are distinct from each other in both forms. Ninth, the posterior foot resembles considerably that of Chrysochloris, with manifest differences; and is similarly related to the anterior foot in proportions, and in the number of its digits, five to four, both genera. Tenth, the dentition.

Here the characters are remarkably like those of Chrysochloris both in the number and detailed structure of the teeth. The anterior incisors are long in the latter, and in Notoryctes there is no heel to the inferior true molars, thus resembling the true genus Chrysochloris.[1]

Such an aggregate of resemblances to the Chrysochloridida signifies, it appears to me, zoological affinity. Whether Notoryctes will ultimately be found to enter the Marsupialia or not, it must be a descendant out of the same stock as that which gave origin to the Chrysochloridida. But I suspect that the brain, female generative organs, and fœtal characters will turn out to resemble those of Chrysochloris, as do its other characters, and in that case Notoryctes will enter the Insectivora. In this order it will form a special family, Notoryctidæ, characterized by the presence of a symphysis pubis; the coossification of the posterior part of the ischium with the sacrum, and perhaps by the coossification of the cervical vertebræ. Perhaps there should be added to these characters, the fusion of the sacral metapophysis into a continuous roof, and the ossification and fusion with the first rib of its hæmapophysis.

The tritubercular molars, the large caudal intecenntra, the cloacal penis, show Notoryctes to be a primitive type. As to resemblances to Monotremata, such as have been suggested by a recent author, none exist. On the contrary, the Notoryctidæ realize a desideration to mammalian phylogeny, viz: a form which connects the marsupial with the placental mammalia, although it is a specialized representative of this type. That the insectivora are the connectant forms among placentals has been long suspected and, that the connection is polyphyletic is suggested by Notoryctes, since the Creodonta are also candidates for this position, from the resemblance of some them to the Dasy-

[1] There are three genera of Chrysochloridida, which are distinguished by the following dental characters, already pointed out by authors (See Dobson l. c. p. 109).

Teeth 40; lower molars without heel; *Chrysochloris* Cuv.
Teeth 40; lower molars with heel; *Bematiscus* Cope.
Teeth 36; lower molars with heel; *Amblysomus* Pom.

Chrysochloris includes only the *C. aurea;* Bematiscus includes *C. villosa* and *C. trevelyanii;* and Amblysomus the *C. rutilans* and *C. obtusirostris.* All are South African.

uridæ. The structure of the pelvis approximates that of a number of the Edentata, as do apparently the inferior incisor teeth. The origin of the latter order has yet to be discovered.

The existence of a South African type of placental mammal in Australia need not greatly surprise us, since the fresh water fish *Gonorhynchus greyi* is common to both countries, and the ratite birds and pleurodire tortoises are found in both.

Explanation of Plates.

Copied from Prof. Stirling's Memoir in the Transactions of the Linnean Society of South Australia.

Plate IX.

Notoryctes typhlops Stirling, natural size, side view. Fig. 2, muzzle from front.

Plate X.

Notoryctes typhlops, skull and dentition enlarged. Fig. 1, skull side view. Fig. 2, lower jaw from behind. Figs. 3-6, superior molar from within, without, from front, and from below. Figs. 7-10, inferior molar, from within, without, above, and obliquely. Fig. 11, skull from below.

A BURIAL MOUND OF FLORIDA.

By Clarence Bloomfield Moore.

Florida's burial mounds of sand are fast disappearing through the fruitless search of the treasure-seeking native or the unsystematic explorations of the relic-hunting tourist from

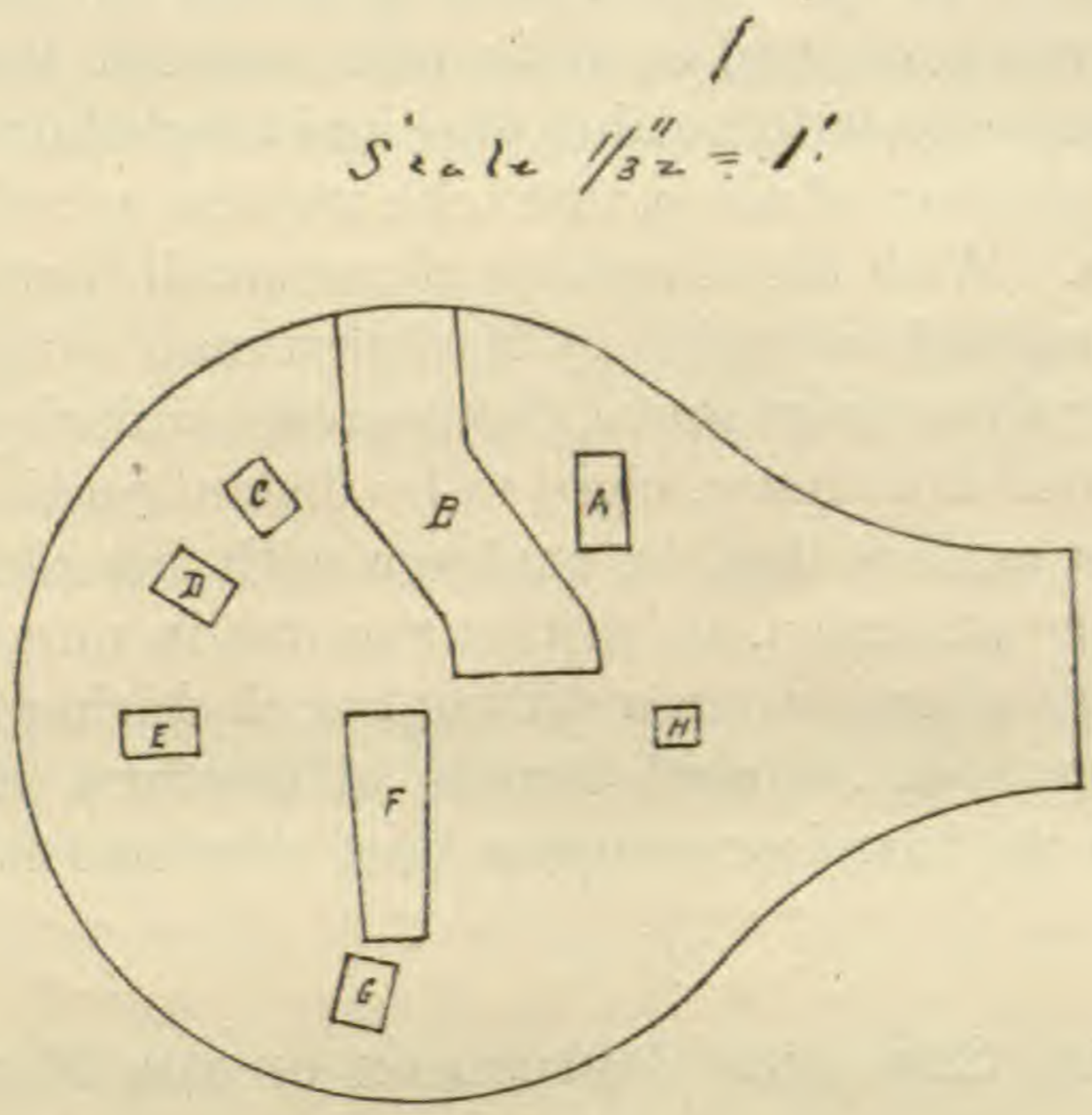

Fig. 1.
Ground Plan of Work.
A, B, C, D. E, F, G, H, various shafts and trenches.

the North. In view of this it would seem fitting to put upon record a comparatively thorough exploration of a somewhat remarkable burial mound previously unopened, and probably unknown to those making scientific investigations in connection with the burial mounds and the shell heaps of the State.[1]

[1] The late Jeffries Wyman, in referring to shell heaps not far distant, makes no mention of this mound in his memoir on "The Fresh Water Shell Mounds of the St. John's River, Florida," although carefully indicating all burial mounds coming under his notice. Le Baron, in a long list of the mounds from the mouth to the source of the St. John's (Smithsonian Report, 1882, page 771 et seq.), makes no reference to Tick Island. [It is not included in Thomas' "Catalogue of Prehistoric Works," 1891.—Ed. Am. Nat.]

Tick Island, Volusia County, Florida, is reached from the St. John's River by turning east and crossing Lake Dexter to the mouth of Spring Garden Creek, and by following the course of this creek until a tumble-down wharf of palmetto logs is reached, from whence a path half a mile in length leads to the burial mound.

Tick Island is separated from the mainland by a narrow waterway, its other boundaries being Lake Woodruff and Spring Garden Creek. The Island presents in parts a very wild appearance, covered as it is with gnarled live oak and towering palmetto, with trailing vine and tangled undergrowth, where the presence of the rattlesnake imparts a certain risk to exploration. With the exception of one small house upon the island, at intervals occupied by the hired man whose care it is to look after the orange grove, the nearest point where quarters can be secured is at Astor, eight miles distant on the river. It is, therefore, evident that the explorer with his assistants and the necessary workmen, at least four or five in number (for the throwing out of sand from a stifling trench during a hot Florida day demands frequent change of laborers), must either camp upon the island or occupy a boat chartered for the purpose.

Shape, Size, and Composition of the Mound.

The burial mound, seventeen feet in height (spirit level and tape line measurement) and in circumference four hundred and seventy-eight feet, is conical in shape, save to the East, where from the summit a gradual slope extends into a winding causeway or breastwork three hundred and ninety-two feet in length (tape line measurement), averaging four feet in height with an average breadth of twenty-five feet at base and fifteen feet at summit. The description of the composition of the mound is based upon careful observation through parts of ten days of February, March and April, 1891, during which time eight shafts and trenches were dug, the largest being forty-six and a half feet long with an average breadth of thirteen feet, and nine feet deep at the end, having from the level of the ground

followed the sloping base of shell to a point three feet vertically from the centre of the mound where operations were suspended owing to the difficulty and danger of the work, arising from the frequent caving in of heavy masses of sand. It is of course possible that an entire demolition of the mound might to a certain extent modify the conclusions embodied in this description, although in every case the results of the digging correspond in character.[1]

Dr. Brinton in his interesting chapter on the antiquities of Florida (The Floridian Peninsula), states that during his investigations he met with no stratification in the formation of any of the larger burial mounds. To this the Tick Island mound is a notable exception.

The base of the mound is composed of shells, apparently brought from the neighboring shell fields to serve as a foundation in the marshy soil.

Across the centre of this layer of shells from North to South runs a ridge of pure white sand, more like the sand of the ocean than of the surrounding fields. Above this ridge of white sand is a stratum of dark sandy loam mingled with shells,[1] while the sides of the ridge are rounded out with sandy loam in which shells are wanting, thus forming a symmetrical mound. Through the layer of shell but slight excavation was attempted, owing to its great compactness, its slope being followed at about six inches below its surface. The main trench, running in the same direction as the ridge, followed its course, and at the point where the excavation ended, the layers were respectively five, six, and three feet in thickness.

In the burial mounds at Lake Harney, at the Indian Fields on the Upper St. John's, on Dunn's Island, and at a point on the Eastern bank of the river about eight miles below Enterprise, no stratification was observed, but these mounds having

[1] Portions of the subject matter of this article are contained in a report made to the Peabody Museum of Archæology, accompanying the bones, pottery and implements secured during the investigation.

[1] It is an interesting fact that the shells of the fresh-water snail of the burial mounds and the shell heaps are larger in size than can be found at the present time in the river and adjacent lagoons.

been opened frequently are now of little value to the archæologist.

Human Remains.

During the excavations at Tick Island over one hundred skeletons were exhumed, and that many hundred still remain is beyond the shadow of a doubt.

The skeletons except one (now at Peabody Museum of Archæology) were in a very friable condition, owing to the

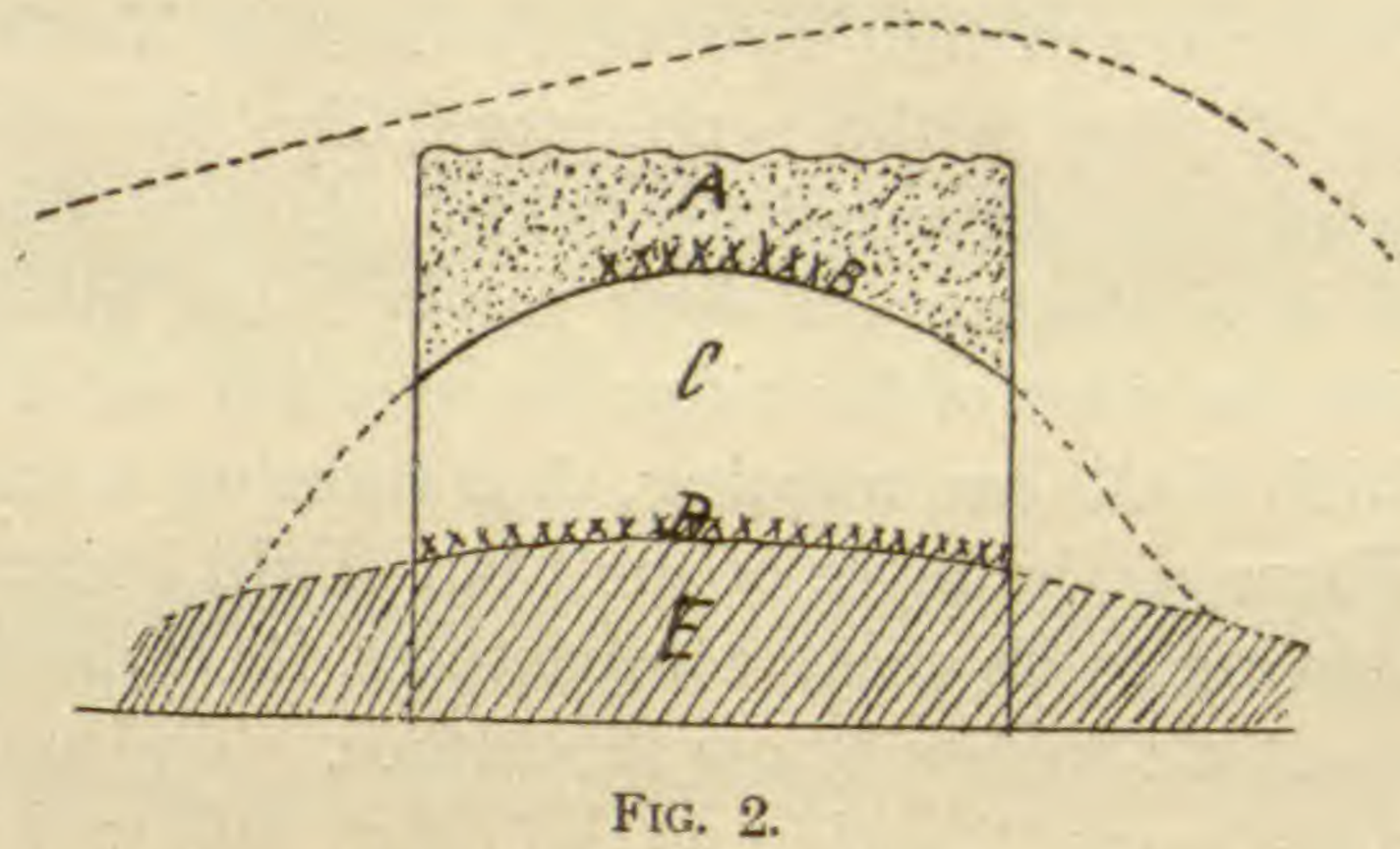

Fig. 2.

End Section of Trench B.

A, layer of sand and loam mixed with shells, B, skeletons on white sand; C, layer of white sand; D, skeletons on the shell; E, shell foundation of mound.

moisture of the sand, requiring the utmost care in handling, and even in the majority of cases rendering futile the most careful efforts to save them. The skeleton recovered entire was in the main trench five feet from the margin of the mound and three feet from the surface. It lay imbedded in the shelly base and through impregnation with lime from its surroundings it had escaped the decay occuring to such a marked extent in all the others. Above it the various strata were undisturbed, showing it to be from no intrusive burial, that *bête noire*

of the careful investigator of mounds which has led at times to so many erroneous conclusions.

The skull of this skeleton was small and round, as were all exhumed at Tick Island in a condition to bear investigation, since the large majority crumbled to pieces upon exposure to the air, or were found crushed through the weight of superimposed sand. No other bodies were found in the shells, but upon

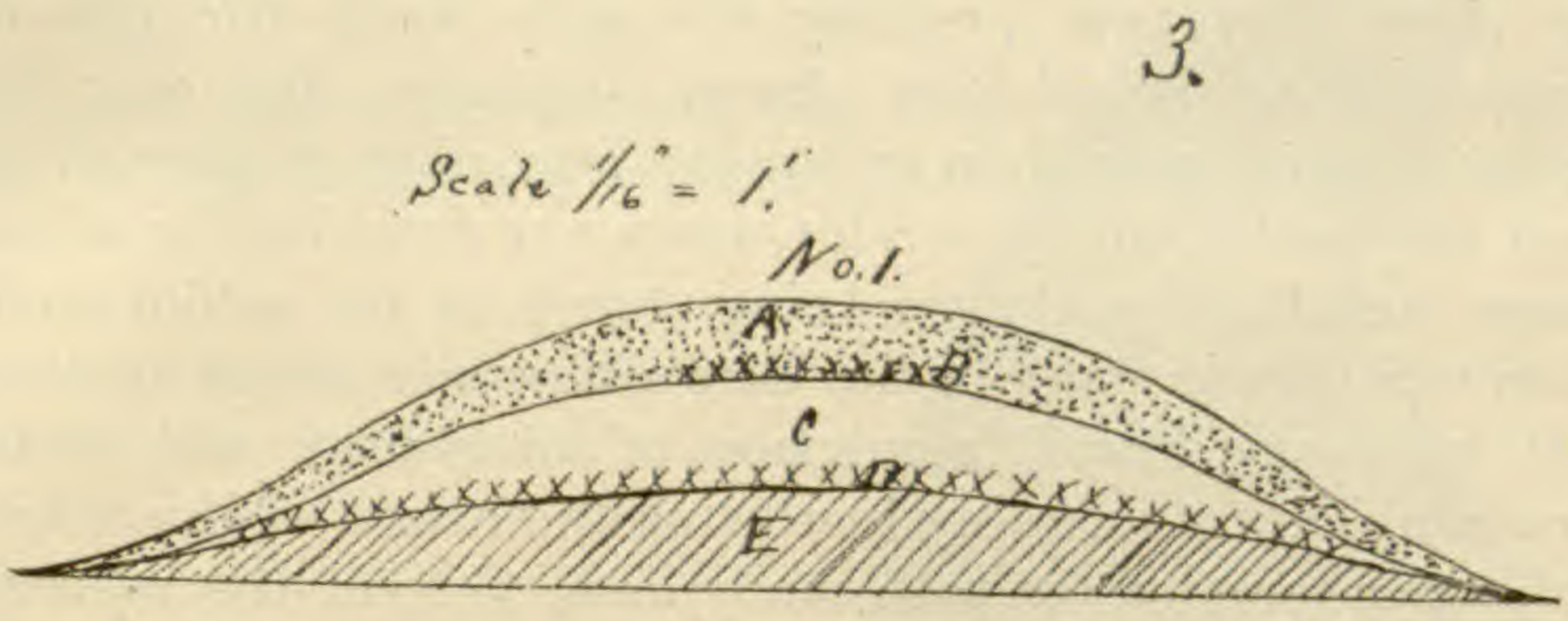

FIG. 3 (1). Section of Mound from North to South.

A, layer of shell, loam and sand; B, skeletons on white sand; C, ridge of white sand; D, skeletons on shell layer; E, shell foundation of mound.

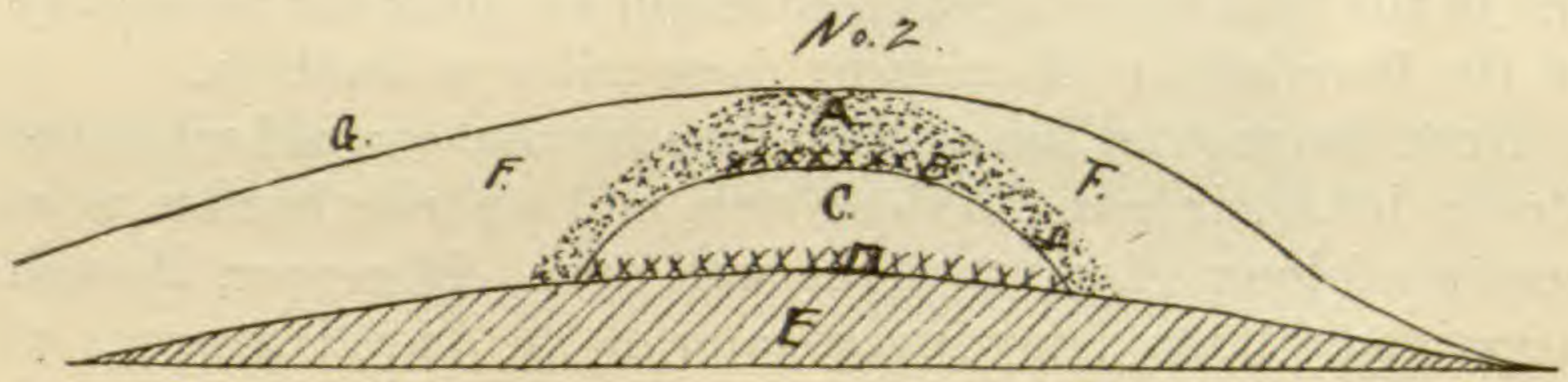

FIG. 3.

FIG. 3 (2). Section of Mound from East to West.

[Lettering same as above.]

F, sand and loam added to fill out the mound; G, gradual slope from the causeway to the summit of the mound.

it, covered with pure white sand, lay numerous skeletons of adults, in some cases the skulls in immediate contact, and this layer of bodies apparently continued through the mound. There seemed to be no fixed position for burial, the bodies lying as though thrown without arrangement, often with arms and legs flexed, and in one case the head pushed down to one

side to such an extent that a portion of the clavicle had entered the mouth.

Several facts in connection with this layer of bodies lying on the shells are very suggestive. All were adults save one, a little child, near whose head three small pots of clay were found. The bodies lay in close juxtaposition, the skulls of some crushed in as by a blow from a blunt instrument; the bones of all the bodies lay in anatomical order, while the white sand in the ridge above was precisely the same shade throughout. From all this it would seem almost conclusive that over the bodies of many men slain in battle a long ridge of pure white sand was erected, and this ridge was never disturbed by subsequent burials, no skeletons being found in the white sand. However upon it many bodies were afterwards placed at intervals and covered with a mixture of sandy loam and shells intermingled, considerably increasing the height of the ridge, which was rounded out with sandy loam to form the mound.

We are told that the lower Creeks and Seminoles hid the bodies of their dead save in the case of a victorious battle, when a mound was raised over them, a fact that would still farther strengthen the conclusion arrived at, were it possible to attribute to the Tick Island mound an origin as late as the occupancy of the Peninsula of Florida by those tribes of Indians.

Upon the mound lies a fallen live-oak that was old when the Creeks left their home to the North, and separate burials were continued long after the fight was over. Moreover, though negative testimony, any investigator of the burial mounds of Florida knows how frequently in post-Columbian times articles valued by the deceased were buried with them, and that, on the river at least, mounds erected or used for intrusive burials after the coming of the whites teem with beads of glass, and that pieces of copper, tomahawks of iron, beads and trinkets of silver and even ornaments of gold are[1] occasionally

[1]The supply of iron, copper and silver among the Indians of Florida, must be considered as obtained through the medium of the whites, and this is probably true with respect to gold which, with the silver, was derived from shipwrecks on the coast. It has been asserted that some gold found its way south from the Indians of the north of Georgia, an opinion which Mr. A. E. Douglass, to whom the author is indebted for many valuable references, has ably combated in the *American Antiquarian* for January, 1890. As to ornaments of metal found in Florida, see paper by Le Baron, Smithsonian Report 1882, page 791 et seq.

PLATE IX.

Notoryctes typhlops.

found in them. In the mound at Tick Island, though careful searchers examined each spadeful of sand, not a bead of glass

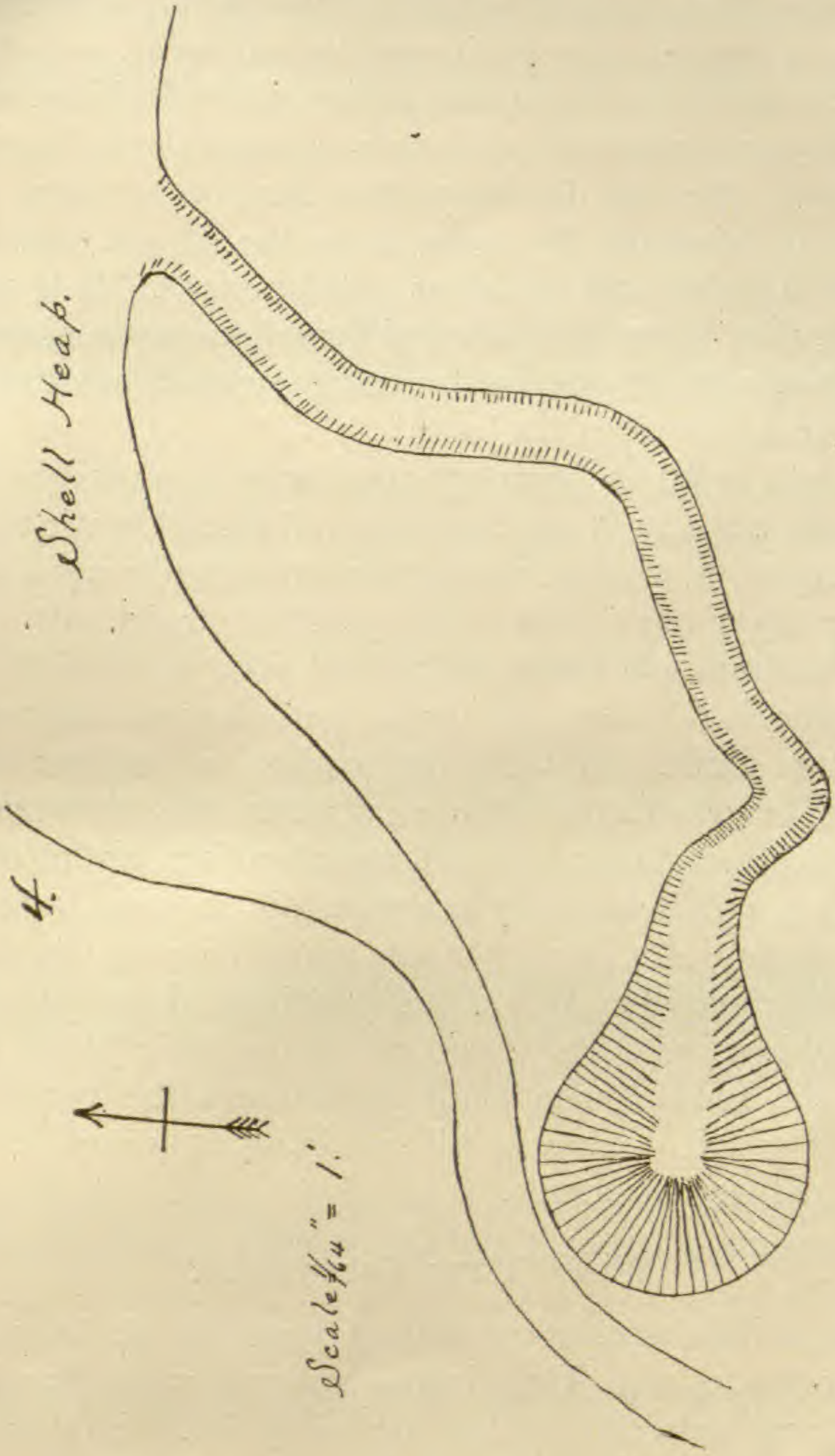

FIG. 4.

Plan of Mound and Causeway.

nor a particle of metal was discovered, a fact very strongly pointing to the conclusion that the mound was no longer used

for burial purposes when the first white men settled in the State.

In many places near the surface of the mound separate bones, or portions of skeletons not in anatomical order, were brought to light, suggestive of a custom of the earlier Indians, who are known to have exposed bodies to the elements or to have buried them until, through decomposition they were more readily enabled to separate the flesh from the bones, which were gathered together and buried at stated periods. It is possible, however, that separate bones (and these bones were always near the surface) were due to the disarrangement of previous interments caused by intrusive burials.

The teeth in all the jaws exhumed were remarkably perfect. In no case was any decay apparent and almost never was there a missing tooth, though many were unusually worn as from chewing upon hard substances, possibly fragments of shell found in conjunction with their usual diet.

A number of bones of great pathological interest were brought to light. In three excavations a number of tibiæ were found marked with anterior curvature, great increase in circumference and abnormal roughness of surface, giving evidence of a chronic inflammatory action, while in one instance, at least, a portion of a shin bone was found bearing the marks of acute inflammation. While the condition does not offer absolute evidence as to the existence of a certain blood disease[1] among the Indians who made the mound, the period of the origin of which disease is still in doubt, it is certain that it would produce like results.

Were They Cannibals?

In immediate association with at least five skeletons in the lower levels of the Tick Island mound were found bones charred and calcined by the action of fire. Of these bones portions were positively identified as belonging to the cranium and ulna.

[1]The American Journal of the Medical Sciences, August 1891, "A Contribution to the Study of Pre-Columbian Syphilis in America." By James Nevins Hyde, A. M., M. D.

That the makers of many of the shell heaps of the River were cannibals is everywhere admitted since the researches of Professor Wyman; and the writer, in January, 1873, found in a shell heap in a swamp near the west bank of the St. John's, a few miles north of Palatka, in association with the bones of the deer and other animals which had been similarly treated, many human bones showing the action of fire, and split, presumably more readily to extract the marrow. With them lay an arrow head of bluish flint. We do not know that the makers of the burial mounds and of the shell heaps were contemporary, and in the burial mounds, with the exception of the one at Huntoon's Islands, referred to by Professor Wyman (Fresh Water Shell Mounds of the St. John's River, Florida, page 28) the writer has been unable to learn of any discoveries pointing to the use of the human body for food. But the presence of these charred human remains would be difficult to explain save by the hypothesis of cannibalism or human sacrifice by fire, in which event, cannibalistic rites might possibly be included.

Perforated Crania.

Among the objects found in the Tick Island mound were two portions of separate crania; one with two perforations about the circumference of an ordinary lead pencil, the second with a similar hole in the centre and the evidence of another on its margin. The origin of these perforations is difficult to explain. No weapon known to the Indians could have caused such a perforation by a single blow, and even admitting the presence of the whites, no bullet or buckshot could have caused the holes, since the perforation was of equal size and regularity on either side, with no splintering of the inner table, as is the case with gunshot wounds of the skull.

Not far distant from these fragments was found a piece of bone (unidentified) with a perforation half an inch in diameter. In many parts of Florida pieces of shell, pottery and stone are met with, having single and double perforations, and were probably used as talismans, though it is possible that in the case of the pottery the perforations made from either side and meeting in the middle, precisely in the manner

described by Professor Morse[1] as existing in fragments of pottery, found in the shell heaps of Japan, served the same purpose as there, to furnish means of strengthening cracked earthenware or of joining that already broken. Be this as it may, perforated objects of stone and shell are found which must be considered as charms and amulets, and it is possible that the fragments of bone were put to a similar use.

But the cranial perforations at least admit of a very different explanation, if we suppose the skulls to have been buried entire with subsequent separation through pressure of sand or through decay. While perforated crania in Florida are hitherto unreported, barring hearsay testimony, their discovery is no novelty in Michigan, where numbers have been found in the great mound at Rouge River and others near Detroit. It is presumable that these holes were made more readily to suspend the cranium of an enemy, similar perforations, it is stated, being formerly customary among the head-hunting Dyaks of Borneo. For fuller details as to perforated crania the reader is referred to *American Antiquarian*, vol. xii, p. 165, and vol. ix, p. 392; also to Henry Gillman's most interesting paper in the Smithsonian Report for 1875, p. 235, et seq.

Pottery.

From the Tick Island mound hundreds of pieces of pottery were taken, the great majority rude and unornamented, the rest decorated with lines, with crossed lines and with knobs, the latter a form unfamiliar to the writer. In no case in any part of the mound were fragments of pottery discovered that had any connection with each other, no matter how closely associated. From the lowest level, pottery showing equal advancement in the arts was taken as from near the surface. It is safe to infer that these bits of pottery, many of which were shaped in a form suggestive of lance heads, were placed with the dead in fulfilment of sacred rites. The presence of broken pottery in the upper portions of the mound where the sandy loam was mixed with the shells could readily be explained by the supposition that the soil brought from the

[1]Shell Mounds of Omori, Tokio, 1879, p. 9.

neighborhood of the shell fields would naturally be intermingled with debris, but in the lower portions of the mound where pure white sand alone covered the bodies, two or three pieces of pottery were almost invariably found in close association with each skeleton usually near the skull. The Etruscans often buried hollow jewelry with their dead, doubtless not caring to waste solid ornaments on the departed. May we not infer then, that the savages of Tick Island, wretchedly poor, since not even stone was indigenous, hesitated to bury with the disceased his most precious implements upon which his descendants doubtless looked as a coveted inheritance, but rather satisfied their cupidity and their conscience by the interment of fragments of pottery in place of the cherished weapons and implements of stone.

Implements, Weapons and Ornaments.

In the main trench were found: three small earthenware pots, unornamented, lying near the body of a child an arrowhead of whitish flint; a small chisel of stone; two discs of shell, each with two small perforations; a small pebble of quartz from the seashore, around the lesser end of which a groove had been cut; four beads of shell and a number of chippings of flint. In a large excavation made on the south side of the mound were brought to light: a spear head of flint, five inches in length; one rude arrow head; one flake of flint; a large quantity of small shell beads; three barrel shaped beads made from the columella of the Busycon, or conch, two, one inch in length, the other, one and three quarter inches. Large shell beads of this kind, probably made in Florida, have been found as far north as East Tennessee[1].

Is it a Serpent Mound?

If any effigy mounds are to be found in Florida, they are of exceeding rarity. During fifteen winters spent in the State, none have come under the notice of the writer. In Emblematic Mounds and Animal "Effigies,[2]" is cited a description by S. T. Walker of an effigy mound in the form of a

[1]Fresh-water shell Mounds of the St. John's River, p. 56.

[2]By Steven D. Peet.

turtle on Long Key off the south-western coast. The author is not entirely persuaded that the shape arose from design; he informs us, however, that turtles abound in the vicinity. This is the only allusion to an effigy mound in Florida that the writer has been able to discover.

As has been stated, a long and winding causeway joins the Tick Island mound, which on this side, sloping[1] to meet it is much less steep than elsewhere, and were the palmettoes and undergrowth cleared from the causeway the resemblance to a serpent would be strong.

In the rainy season the territory surrounding the burial mound becomes soft and swampy, and a causeway to the place of sepulture would prove a great convenience and for this purpose the causeway doubtless served, though its winding shape may have been intended also as emblematic. The raised pathway terminates at a large bean-shaped shell or refuse heap, upon which and the adjacent acres of shell-fields the Indians doubtless lived, and if the causeway were to serve as a means of communication alone, it seems fair to suppose that the natives with their limited methods of conveyance would have made it in as straight a line as possible. Moreover, a second causeway, skirting the base of the mound runs in a direct line from the great shell heap, towards the solid hammock land beyond.

It is impossible with our present light to state what race or races[2] piled up the burial mounds and by the slow deposit of debris formed the vast shell heaps of the river and of the coast, since many mounds give no evidence of intercourse with the white men, while such as do, may furnish their beads of glass and ornaments and implements of metal through the intru-

[1]This slope is found in many burial mounds, but not such a causeway.

[2]Prof. Wyman [Fresh-water Shell Mounds of the St. John's River, Florida] has estimated the age of a live oak fifteen feet four inches in circumference growing upon a shell heap investigated by him, to be not less than three hundred years. On a shell heap in the immediate vicinity of the burial mound at Tick Island, grows a live oak twenty three feet five inches in circumference. Moreover, as Professor Wyman points out, the age of trees upon shell heaps can furnish but a minimum estimate since centuries may have elapsed before the sprouting of the oak. It must, however, be borne in mind, that conclusive proof never as yet has been furnished as to the contemporaneous origin of the shell heaps and of the burial mounds of sand.

sive burials of later Indians. Hence all data are wanting as to the superstitions of the Indians who built the mounds. Still, it is well known how widely the cult of the serpent has obtained in various parts of the world, and it is not unlikely that the savages of Tick Island, where the Crotalus and other snakes are numerous, if erecting an effigy mound, should give it the form of a serpent.

We are told[1] that the Indians of the sixteenth century along the St. John's, held the serpent in veneration and treated with every mark of respect the head of a snake cut off by a soldier of De Gourgues.

Moreover, it is not infrequently the case that a conquering race, when amalgamating with a conquered people in taking possession of the soil, incorporates with its own the worship of the vanquished, and it would seem at least fair to conjecture that the worship and veneration of the serpent descended from the earlier inhabitants of Florida through Indians of whom we have historical record, to the Seminoles.

How the Seminoles of a century ago regarded the rattlesnake is amusingly told by the naive though learned William Bartram, who just before our war of Independence made a journey up the St. John's as far as Lake Beresford.[2]

In the great serpent mound of Ohio the head and the body are of nearly the same height, while a difference of thirteen feet in favor of the head exists in the Tick Island mound. Moreover the head or mound proper has been extensively used for burial purposes. In view of these facts and the probable absence of effigy mounds elsewhere in the state[3] the weight of evidence would seem to bear against the existence of a serpent mound on Tick Island. Nevertheless there are enough points in its favor to justify the writer in hazarding the suggestion.

The Height of the Florida Mound Builders.

Although not bearing directly on the Tick Island mound, yet as applying to it and to many other mounds and shell

[1]Floridian Peninsula, p. 131.

[2]Travels, Chap. IX.

[3]Prof. Putnam in a letter to the writer states that no effigy mound in Florida has ever been brought to his notice.

heaps investigated by the writer on the east coast, the west coast and the River, a few words as to the stature of the mound builders may not be considered amiss.

In forming estimates from the whole or a part of a skeleton, as to the height of the body during life there is but one basis upon which to go: actual measurement; and unless these data are furnished by men of the utmost reliability, measurements made in person are alone of value.

As the German physicians where no post mortem has been made dismiss useless theorizing as to the cause of death with the simple words "no autopsy" so it is well to put aside all reports of the finding of skeletons which, "judging from their bones must have been of giants."

In all scientific researches of this nature the explorer comes in contact with three classes of inhabitants, the conscientious resident whose memory is possibly defective; the kind-hearted inhabitant, who, having learned what information is wanted, rather than disappoint, will corroborate anything; and the facetious native, who, seeing a city man spending time and money upon what he regards as matters of small import, takes delight in filling to repletion, with marvelous details evolved from his own imagination, the person whom he considers to be a mild form of lunatic.

For a scientist with a theory to establish the native Floridian is an acquisitition beyond price.

On an average the length of the femur is about two hundred and seventy five thousandths[1] of the entire height; thus the thigh bone of a six foot man would be 19·8 inches in length. To those unfamiliar with this relative size of the thigh bone, a femur when found in nearly every case gives the idea of having done duty in a body of abnormal size.

The writer well recalls in March 1879, while engaged in an imperfect investigation of the burial mound at Bluffton on the St. John's, having found a skeleton and in association with it a pipe of stone, an arrow head and a portion of a drinking cup wrought from a human skull and ornamented—an object by the way, of great archæological interest. The femur of this

[1]Professor George A. Piersol.

skeleton seemed so large that it required the assurance of a professor of Harvard to carry conviction to the finder then unfamiliar with the ratio existing between thigh bone and skeleton, that the remains of a giant had not been disinterred.

In the burial mound at Tick Island, over one hundred skeletons were found, none belonging to men of extraordinary size, while the same holds good in the case of very many skeletons excavated by the writer on other parts of the river and the coast, while the same may be said of bones found in orange groves and cultivated land where the spade or plow of the agriculturist had left them. Great pains have been taken by the writer, and considerable distances have been traveled to inspect the bones of so-called giants and ever with a like result. The bones, if forthcoming at all, have never indicated a greater stature than can readily be found among the white men of to-day.[1]

It is true that Dr. Brinton (The Floridan Peninsula, page 171) cites a case reported to him of the finding in that State of skeletons of abnormal size. In this instance, no measurements were made, but it must be remembered, however, that even conscientious men, when measuring a skeleton laid at length upon the ground, frequently fail to make due allowance for the interlocked portions, or joints, and arrive at an estimate greater than is justified by fact. Upon the whole, it would not be unsafe to assert that the former races inhabiting Florida contained no taller men than can readily be found at the present time.

[1]The writer in May, 1891, while investigating a burial mound and certain shell fields in one of Florida's coast towns, was waited upon by a professional man of the place and informed of the recent finding of a skeleton nine feet in height. At the close of the interview, it had diminished a foot and the admission was made that the skeleton had not been personally inspected.

The writer next sought his informant's informant. According to him the skeleton was seven feet in height "and the skull would hold a peck."

Next the original finder of the bones was visited. He considered the skeleton to have belonged to a very large man, but had made no measurements. The skull alone had been kept. It proved to be somewhat below the average size.

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RECENT LITERATURE.

Kuntze's Revisio Generum. I.[1]—Whenever a work appears in which the nomenclature is not exactly the same as that of the manuals in popular use, the charge is made that the "changes" are wanton and made simply from love of novelty or a desire to bring the author to notice. There may sometimes be ground for this charge when brought against makers of catalogues or writers of short notes in magazines. None of the writers who have treated nomenclature in that strict and consistent manner which renders necessary the abandonment of some familiar names have been in a position to entirely divest themselves of suspicion, as they generally made their investigations from the start with the sole purpose of determining the validity of names in use—not as incidental to some other work. These charges cannot be made with the same force against Kuntze's Revisio Generum —the most extensive and complete as well as one of the most radical revisions of nomenclature that has yet appeared.

Kuntze made a tour around the world from 1874–1876. He began to study and classify his collections made on that tour in 1884 at the Herbarium at Berlin. He worked there until 1887, when he went to Kew, where he continued his work until the end of 1890. The result is his "Revisio." It will be seen, therefore, that he did not begin the work of revision in cold blood of malice aforethought, but was drawn into it in the course of other investigations. In classifying his collections he attempted to do something more than identify them. He studied them, and as a result wrote several monographs, of which he published some separately and incorporated others in the present work. In the present condition of nomenclature, he found that next after the proper limitation of a genus or species, the determination of the name to be applied was of the highest importance, and that the latter had become a much more difficult task in some instances than the former, as those who had worked at the one with the greatest care had used little or no care in the other. He decided to examine the names he applied with the greatest care and to reach as far as possible a permanent result. The great extent of homonymy and synonymy made it necessary for him to examine every generic name in use in order to be sure that he was giving one whose title could not be

[1] Revisio Generum Plantarum Vascularium omnium et Cellularium multarum secundum Leges Nomenclaturæ Internationales cum Enumeratione Plantarum in Itinere Mundi Collectarum—Mit Erlaeuterungen. von Dr. Otto Kuntze, 1891. (In two parts).

doubted. To do this thoroughly, implied a revision of all the genera and he proceeded at once to examine the original sources and make a revision *de novo* instead of contenting himself with leaning upon the work of others. What ever may be thought of the result, in this case the motive can hardly be impeached. And it must be said, however radical his views on nomenclature seem, that in all other respects he is in the main very conservative. He repeatedly expresses his approval of Bentham and Hooker's limitations of genera and condemns severely the multiplication of genera or species.

He bases his revision upon the rules of the Congress at Paris in 1867, giving them a strict construction in order to prevent any doubt. He shows that these rules have not been followed in practice, but that there is no alternative between them and chaos in nomenclature. Some confusion has arisen also from defects in these rules—or as he expresses it, he found "leaks" in them. These leaks he has attempted to repair by framing additions and amendments to the rules. He made a thorough and complete revision of all the genera of Phanerogams and Pteridophytes and of many genera of Bryophytes, Fungi and Algæ which came to his notice in revising the nomenclature of the Phanerogams—as he was forced to examine everywhere to be sure that the names he adopted were not in prior use elsewhere. There is no complete unity in the work, for, besides the revision of nomenclature, in a few cases he has made a revision of the contents of a genus, or a monograph of the genus or some part of it, perhaps extending even to forms of a species. There is also a list of plants collected on his tour, dovetailed into the revision. The book seems to be a compilation of the work he did upon his collection or which he was drawn into in the progress of that work. It would take a critic almost as long to verify the work as it did the author to do it, and I wish it understood that the statements hereinafter made are on the authority of the work itself unless otherwise indicated.

The book opens with a long and somewhat rambling preface in which the author describes the circumstances which led him into the work. He then takes up the vital question of the necessity of such a revision and gives three principal causes of the alterations he has made. The first arises from matters of form as prescribed by the international rules. Some of these he has formulated more strictly and "completed in order to abate the multitude of variations and to bring controverted cases to an easy decision." "Many persons," he adds, "will recognize for the first time out of the mass of alterations the difficulties which inconsistencies in this respect may produce and the

necessity of fixed ground principles for nomenclature." The second cause is, "Correction of and atonement for accomplished wrong. This is the greatly preponderating cause of the restoration of many rightful names." "It is strange," he continues, "that the children of Flora, the advocates of *scientia amabilis* have so often given occasion in their naming '*nichts weniger als* amabiles *zu sein*' towards their comrades." The third cause is that monographers and universal systematists have mostly slighted the revision of generic names. Where they have had it brought to their notice, they have made some revisions, but for the most part they have taken what names they found. "Monographers," he says, "ought to have such revision in view next after their principal object; but they are often not in a position to do this, as in the correlation of homonymy the nomenclature of the whole system must be examined, for which the monographers mostly have not the requisite materials. In the concentration of their powers upon the internal work of the monograph, this revision is often discontinued. The universal systematists moreover, rely principally upon the monographs and seldom correct them—in this *circulus vitiosus* a careful study of the older sources is let slip by all."

In the introduction to his revision he supplements this statement by a detailed account of the causes of the present state of nomenclature; and the large number of examples which he gives certainly show a much more chaotic condition than one would suppose, even in spite of the discussions going on in the magazines, and the unfamiliar names to be met with in every new catalogue. "Above all," he says, "my revision shows that the present condition of botanical nomenclature is still very unhealthy. The great Linné indeed reformed Botany, but unfortunately he introduced a taint at the same time which has transmitted itself with botanists.....namely unfairness towards coworkers. If this taint does not disappear, the international nomenclature must perish, and this aid to an understanding between botanists become bankrupt. The botanical Congress in Paris in 1867 first made way for the cure. I hope through this work to accelerate it."

He also discusses in the preface the "Benthamain-rule" that a species-name is only an incident to the genus name and the international rule that "a name is a name." He criticises Bentham quite severely, and in the main justly, and gives some interesting examples of the way he multiplies species-names on changing a species from one genus to another. He shows that this was a general practice of the successors of Linnæus and of botanists early in this century, and observes that it is not to be expected that Englishmen will abandon this old

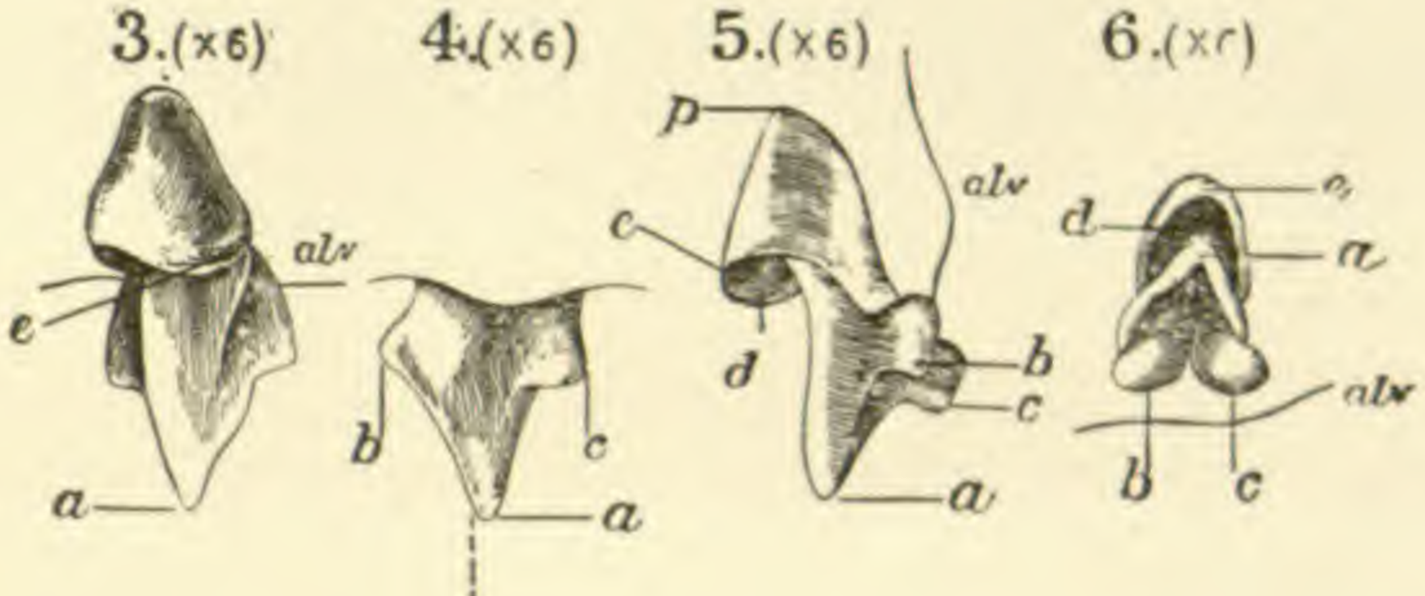
method merely because it produces inconvenience and confusion and adopt the international principle, any more than that they will even adopt the metric system or the centigrade thermometer or decimal system of money. In this section of modern English nomenclature he enlarges upon this in discussing "the renewed Kew rule" which is nothing but Bentham's rule again. He then discusses author-citation. After devoting some time to criticising the Boisierian or "pietistic" method, he gives his own view which is somewhat novel. The following extract also shows a characteristic of the book which strikes one very oddly at first. That is its polyglot composition (of also the title). English, French and Latin come unexpectedly upon the reader in the midst of the German on every page. The words in italics are in English in the original.

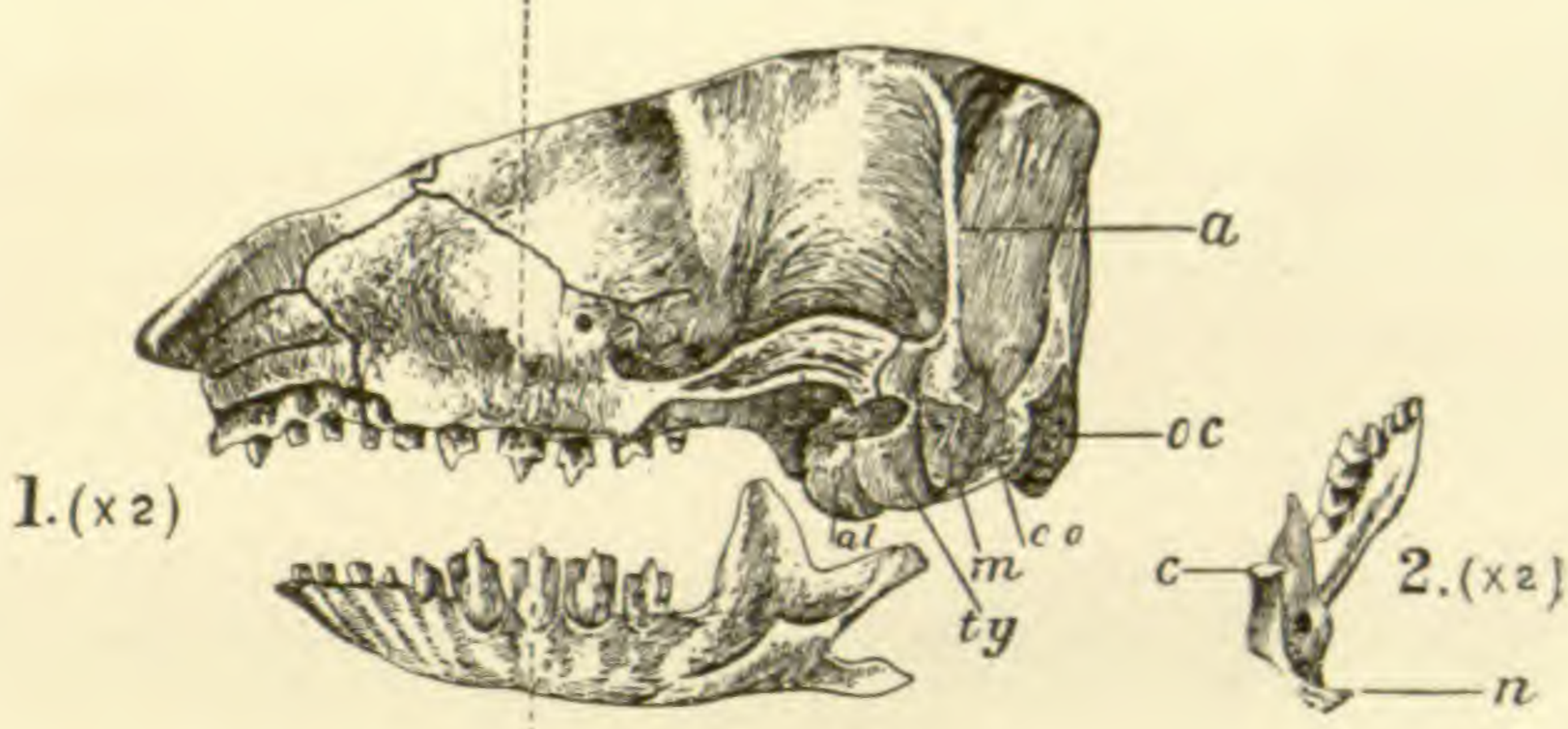
"Convolvulus reptans L. 1753 = Ipomœa aquatica Forsk 1775 (*misfortune or mostly piracy*) = Ipomœa reptans L (*pietism*) = Ipomœa reptans (L) Pois (*seduction*) = Ipomœa reptans Pois (L) (*correctness*) = Ipomœa reptans Pois (*International*)." He thinks that "Ipomœa reptans Pois (Convolvulus reptans L.)" is the proper citation, and as an abbreviation of that he gets I. reptans Pois. (L.) "Earlier," he continues, "it seemed to me indifferent in which position the two authors were to be cited. But the citation of both authors in the sequence which I have denominated 'seduction' seduces through the practice of abbreviation by omitting the 'Pois,' unconsciously to the false method of pietism.....and is therefore to be rejected."

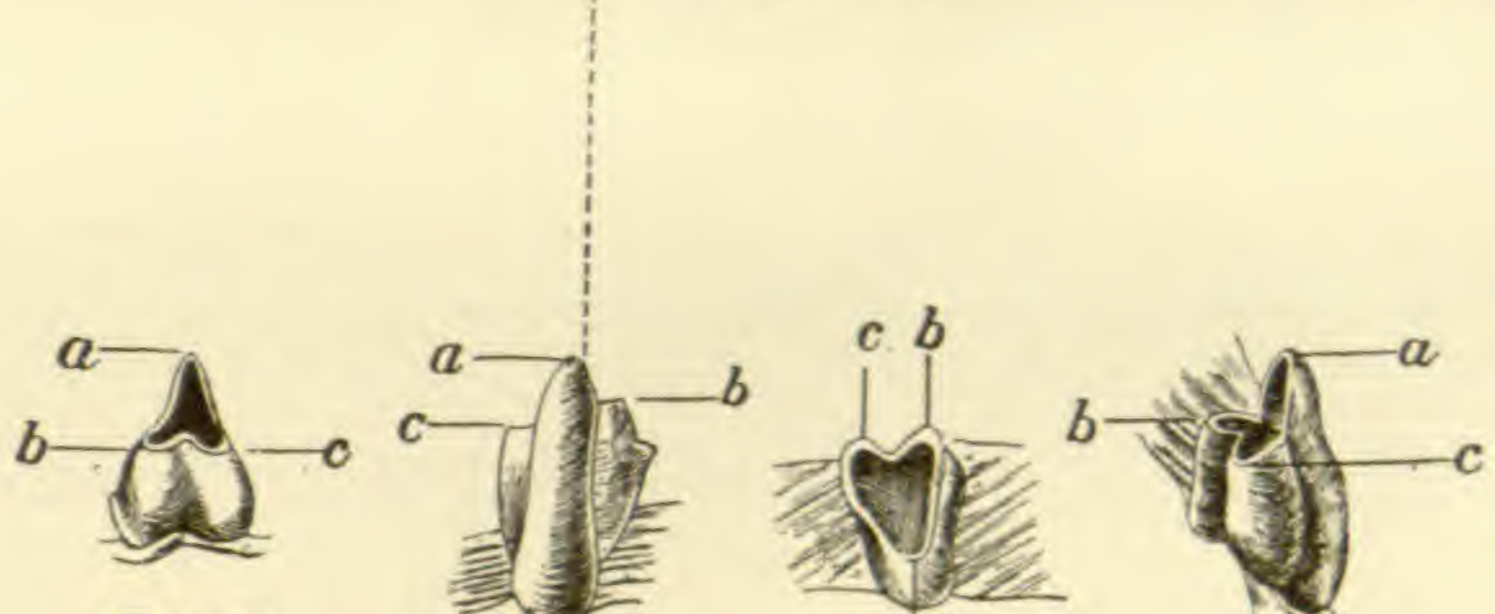
Admitting that "the citation of two authors alone leads to order" does it follow that the evil he deprecates will be obviated by the method proposed? Will a lazy or a hasty man be more certain to abbreviate by omitting the last author than by leaving out the first? Will he not be pretty sure to leave out the name in parenthesis wherever it stands? Or at least will he not be governed by a bias toward pietism or the reverse quite as much as by the order in which the names are written? It seems to me that his objection is fanciful and that his citation might well be termed "*distraction*" as increasing the already too numerous methods of citation.

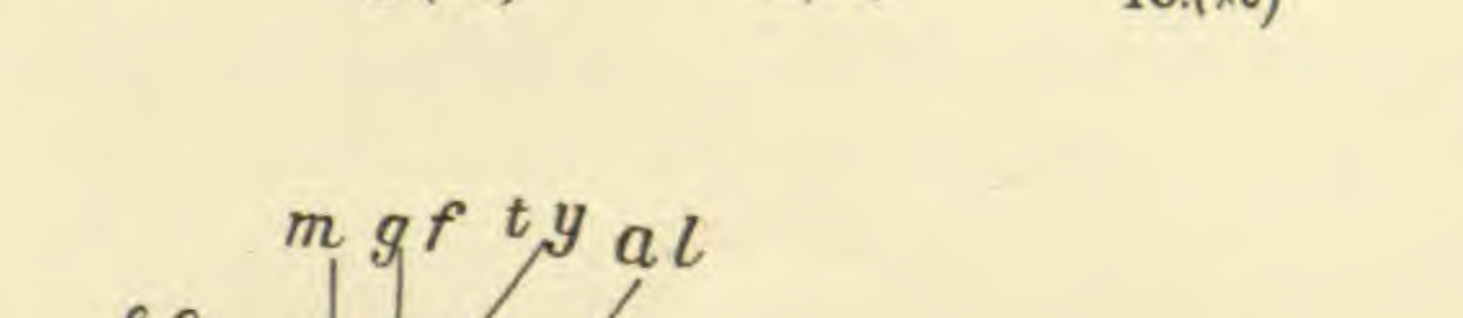
After the preface there is a long introduction. He first treats of the materials for revision. Section 1 is devoted to a severe criticism of Durand's Index to Bentham and Hooker's Genera Plantarum—"BHgp" he abbreviates it. Among other things he charges that a large part of the index, including some errors, is borrowed without credit from Pfeiffer's *Nomenclator Botanicus*.

PLATE X.









Notoryctes typhlops.

Section 2 is entitled "Certain common causes of the many mistakes in Durand's Index and on the future prevention of such mistakes." The first cause is inconsistent treatment of authors. Some are entirely neglected unless they were the emendators of a genus, while other "*beliebte Autoren,*" though pre-Linnæan, are cited even to emended genera. Another cause, he points out, is inconsistency and confusion in the use of the abbreviations "MS.," "ined." etc. He distinguishes "such names found or given in MS. as are adopted and published by another author" from "names found in MS. which another author rejects, but which are published as synonyms." These he says are badly confused in practice, and he distinguishes the latter as "*nomina inapplicata* (n. inapl)" and the former as "*nomina adoptata* (n. adopt.)" He also points out the confusion resulting from irregular use of *non* for *p. p. emend.*, etc. and shows the cases to which it should be restricted. It will be seen that he is very strict as to the smallest details. It often seems as if the distinctions he draws were too small to notice until his formidable lists of the results of looseness are examined. He cites copiously and apparently exhaustively on every point and argues with some force.

In section 3 he considers Pfeiffer's "*Nomenclator Botanicus*" at some length, criticising some parts of it a little. Incidentally he says that neither Pfeiffer nor Durand took enough time for their work, and that as a result the former is "leaky," and the latter *sorgloss fehlervoll.*"

Sections 4–12 deal with the "principal causes of the present condition of nomenclature." Section 4 is entitled "Linné's competition with his contemporaries." Linné, it seems, in reforming nomenclature, besides changing many bad names, "wilfully altered many good earlier genus names" and after 1737 was very free in altering the names given by those of his contemporaries who ventured to criticise him or who did not adopt his nomenclature. Says Kuntze: "Linné was great as an investigator, a discriminating observer, an ingenious thinker with immense talent for 'Systematics,' a tireless worker, an attached pupil, a genial man and on the whole an honorable character; but excessively greedy of honor. Easily accessible to flattery, very prone to neglect of acknowledgment, tolerating no opposition, feeling himself an autocrat; he often needlessly changed names (even those which he himself had previously adopted) and chastised his opponents and '*nichtbewunderer*' by neglect of the names adopted or given by them. He actually held it allowable to criticise the newly created genera of his contemporaries, if he adopted them or to apply

the names to entirely different plants. In this way he monopolized his nomenclature."

How far we may not be forced to tolerate this in Linné because of the necessity of a fixed foundation for nomenclature is a question which perhaps merits more careful consideration than Kuntze has given it. But there is no such reason in the case of Linné imitators, and as the root of all evil in nomenclature, they should not be allowed to escape with impunity. Linné is not the only man who considered himself the autocrat of botanical nomenclature. Subsequently, would-be despots and obligarchies have asserted this authority with great vigor. There are those now who assume a divine right to say what shall be and what shall not be, and, while crying out at all changes by others, themselves often make changes at will; retaining only those names which they or their ancestors have approved and made current.

In this connection Kuntze gives a list of the authors whom Linné slighted and whose names he 'rebaptized' and a number of examples of Linné's method. Two must be given, and they are not the worst: "upon Cardamine lunaria L = Lunaria aegyptica Juss. Adanson based a new genus, Scopolia. 'Immediately on this discovery,' writes Medicus, 'Linné separated it again from Cardamine, recognizing it as a separate genus, but changed the name Scopolia to Ricolia.'" Another case is Heisteria L. 1737, dedicated to Heister, a contemporary. Heister afterwards ventured to remonstrate against Linné's "shameful alterations in nomenclature," whereupon Linné chastized him by changing Heisteria to Muraltia (1767)!

Section 5, entitled "Inconsistencies of Linné and his contemporaries, and their alterations of their own names," continues the same subject, giving a large number of interesting examples.

Section 6 is headed "Brutal lawlessness of nomenclature after Linné until the beginning of the XIX century; Robert Brown, etc." The period treated of in this section might well be termed the feudal period of Botany. "After Linné's death" says Kuntze....."anarchy broke out, as in other cases in history after the death of a reformer and dictator." There were on the one hand the heirs of Linné-*i.e.* the editors of the successive editions of his works, and on the other, a number of imitators of him, great Barons, as it were, none great enough to fill his place, and all more or less at war. Name-alteration went on pretty steadily now, and it is to this period that we are indebted for most of the present disorder in nomenclature. At this time was it that the habit of changing the species name of a plant put in a new genus, which is now perpetuated by the "renewed Kew rule,"

was formed. Says Kuntze: This was the flowering time of botanical robber-knighthood, the followers of which, for a part, were able investigators, but respected no author's right."

His remarks on Robert Brown in this connection are especially interesting. He says: "He was a great botanist *mit allüren eines Despoten*"....." Except Linné, who, however was a reformer of nomenclature and system, and in zeal for their introduction often went too far, no author, relatively, has offered me so many opportunities to correct the names wrongfully introduced or preferred by him as Robert Brown." "Under Robert Brown's great influence, a clique arose (Smith, Richard, Lindley, Wallich, Bentham) which has done marked injustice to certain other botanists.....[Salisbury for one;] yes one can say that he has founded a school in unrighteousness, of which many traces are to be found in 'BHgp.'"

Section 7 treats of "different conceptions of valid genus-formation." He distinguishes and limits *nomina nuda* (names published without description.) "So long," he says, "as the plant is sufficiently known, there is need neither of a plate nor of a description. Only when recognition is impossible, is the name to be marked '*nomen tantum*' or *nomen nudum*, etc." Bentham and Hooker do great injustice to Salisbury by dismissing with the words '*nomen tautum*' etc. the names of valid genera founded by him and published without description, but with reference to well known types upon which they were founded in a way that left no room for doubt. On the contrary they carefully protect the names in Wallich's Catalogue, the application of which, he charges, is sometimes very hard to recognize. "One does not name the description, but the plant, and defective diagnoses are often more perplexing than none at all."

We cannot blame Kuntze for remarking upon the injustice done to Salisbury. But in this case (and it is the only one as far as I have found) he departs from his customary strict interpretation of the rules. Common sense is doubtless on his side. But common sense differs considerably according to the person applying it; and Kuntze has warned us too many times against the slightest relaxation of rules.

Section 8. "Name-alterations by raising sections into genera and through linguistic changes," is the basis of some alterations in the international rules proposed by him. The subject will be considered later.

A very interesting section is section 9, entitled "Homonymy, a powerful cause of name-alteration and abiding source of danger to botanical nomenclature." Most of the cases of homonymy arise from

the repeated use of the same personal name, in the hope, apparently, that it will stick in some one place, and some obscure man can be honored in the end. There are a goodly number however which have not even this semblance of an excuse. Kuntze gives a list of *one hundred and fifty* personal genus-names which have been repeatedly and differently applied in this way—two of them to *seven* different groups, two to *six* groups and *fourteen to five!* As he says, this is a fearful list.

In order to furnish those who are desirous of honoring some person at all hazards a means of so doing without imperiling nomenclature he explains a number of devices by means of which a personal name can be made in so many ways that hereafter there should be no difficulty in providing even for such numerous families as the Smiths and Joneses. He gives a long list of precedents of endings, prefixes and combinations: some very good, some very bad, and a few so atrocious that even he is compelled to exclaim at them. He also gives examples of anagrams and translations—some of them very good—and of "*zusammengezogene*" personal names, of which Pahlomagunsia O. K. is a fair sample. But this is not all. He thinks the termination "ago" when joined to a personal name very euphonious and gives some examples: Pritzelago O. K. To him "ago" suggests "agere" and seems suitable to a compiler. So he would say: Steudelago, Pfeifferago etc. An anatomist would get a "*toma*" attached to his name. (Does this refer to the fact that the person honored would be likely to *cut* him after making such a name?) Linné sometimes attached *inda* to the generic name of an Indian plant. So *inda, afra amra and asia* he considers proper terminations for genera dedicated to travelers or botanists in India, Africa, America and Asia. He makes for us on this theory Watsonamara O K., Schweinfurthafra O K. and many others. Fries made a genus "Aaretis" for M. A. Aretis. This is all well enough for once, but Kuntze takes him up with "Pasaccardoa" O K. (for P. A. Saccardo) and outdoes him with a suggested "Sirhookera." I do not believe such a collection of monstrosities was ever brought together before, the names fairly pack two pages of this section. It would be better that every man he so "honors" be forgotten, than that his name be made ridiculous forever by being joined to "carpum" or "fungus" after the manner of "Peckifungus" O K.; Henningsocarpum" O K.; "Philipimalva" O K etc. The possibilities of the field he has opened up for us are indeed great, witness: Smithia; Smithago; Johnsmithotoma; Igsmithia (J. G. Smith;) Smithialga; Smithodendrum. I dwell on this because it seems to me

that botanical Latin is impure enough already without such gratuitous monstrosities. The rule against names formed from two languages almost reaches them; good taste certainly ought to condemn them. It may be well enough to call attention to precedents for the sake of those who are determined to honor some person at all events, but like tracheotomy, they should be the last resort.—ROSCOE POUND.

(*Concluded in March Number.*)

Systematische and Topographische Anatomie des Hundes, Bearbeitet von Ellenberger und Baum.—*Berlin, Paul Parey*, 1891, pp. 646.—This book was produced at the suggestion of the veteran physiologist, Ludwig, of Leipzig (and one would be obliged to search far before arriving at a field of scientific work in any way related to animal physiology in which his suggestions have not borne good fruit). It is intended for zoologists, veterinarians and physiologists, more especially for the two former, for whom it places the dog on a plane with the horse and the ox, whose anatomy has been carefully worked out. For the physiologist it will rank with the works of Krause on the rabbit and Ecker on the frog. That it has been greatly needed will be acknowledged by all who have had to deal with the dog from the morphological, physiological, or medical standpoints. That it represents a vast amount of faithful labor on the part of the authors, who are instructors in the veterinary college at Dresden, not only in the examination of literature, but more especially in the practical study, with scalpel and forceps, is evident from a survey of the book itself. It is purely systematic and topographical, as the title indicates, all histological, ontogenetic, phylogenetic, comparative anatomical and physiological considerations (except as to the actions of the muscles), being omitted. The rigid restriction of the subject matter in this respect is a detraction and must result in narrowing the circle of users of the book. A broader treatment from the comparative standpoint would have added greatly to the interest and value. In this line the short discussions of the race differences in the various bones of the skeleton are an interesting feature. The physiologist can not fail to notice the lack of good descriptions and figures elucidating the physiological anatomy of the body. He has his Cyon, it is true, but Cyon is not all sufficient. The two hundred and eight figures in the text are with few exceptions original, and mostly of unusual excellence. Thirty-seven plates represent sections through the body in different planes and regions, and are given to show the topography of the parts, chiefly for operative purposes.

As a purely anatomical work it is excellent. It will be much more useful to veterinarians than to any other class of readers and it was largely written for them. However, no one in any way interested in the anatomy of the dog can afford to be without it; and it is gratifying to have the labor performed for the first time so faithfully and so well. An English translation should be made.—MORITZ FISCHER.

General Notes.

GEOLOGY AND PALEONTOLOGY.

The Crystalline Cambrian Deposits in Massachusetts. *The Essex Bull.*, vol. xxiii, 1891, publishes another paper by Mr. J. H. Sears, on the Olenellus Cambrian rocks of Essex County, Mass. The numerous out-crops of these rocks, their position and condition lead the author to the following theory:

That during the Cambrian period a vast sheet of these sediments was deposited over the entire region to the depth of some hundreds of feet. They have been distorted and crumpled into anticlinal and synclinal folds by the intrusion of eruptive rocks. The distortion left their entire surface a series of cracks and faults, which made them a prey to the forces of erosion and decay. The ice sheet during the glacial period scoured these sedimentary beds and ground the rocks to boulders and fine till, which is now scattered over Cape Ann and in the neighboring waters of the Atlantic Ocean. This would account for the absence of glacial grooves on the surface of granite areas, for the ice sheet probably never touched the greater portion of the granite area. Aerial decay has since destroyed all that was left of the sedimentary beds after the ice period, except such remnants as are found to-day. The absence of fossils in many of the beds is due to contact metamorphism.

The Fauna of the Armorician Sandstones.—M. Charles Barrois has recently published (*Ann. Soc. Geol. du Nord. Avril*, 1891) a memoir in which he describes the fauna, and discusses the systematic position of the Armorician sandstones of Bretagne. The fauna consists of 151 sponges, 155 Brachiopods, 157 Lamellibranchs, 212 Gastropods, 218 Pteropods, and 219 Crustaceans. In giving the biological characters of the fauna, the writer calls attention to the very slight ornamentation of the shells of the Lamellibranchs. They are characterized by equal valves and by the length of the cardinal line. A

careful comparison with equivalent faunas of other regions shows that the fauna of the Armorician sandstones is intermediate between the primordial and that of Llandeilo. The advanced types of the Lamellibranchs induces M. Barrois to correlate these sandstones with the lower beds of Llandeilo rather than with those of Trimadoc.

Relations of the Chemung-Catskill Group to the Lower Carboniferous.—In an address before the section of Geology and Geography at the Washington meeting of the A. A. A. S., Prof. John Stevenson suggested that the Catskill as well as some portion of the Chemung may be contemporaneous with the lower beds of the lower Carboniferous of Ohio, and instances the following facts as having a bearing upon the question:

"*First*, That the Chemung and Catskill deposits were laid down in a shallow basin subsiding most rapidly at the East and along a line rudely parallel to the Blue Ridge trench.

"*Second*, That the deposits would be much greater near the mainland at the East than at two hundred miles away; so that six hundred feet more or less of fine material in Ohio would more than fairly represent the four thousand feet of Chemung in Eastern Pennsylvania.

"*Third*, That the water beyond the reach of the great land wash held a Chemung fauna throughout the whole line of the Catskill deposit." (Proceeds. A. A. A. S., vol. xl, 1891.)

Water-Bearing Horizons of Southern New Jersey.—Mr. Lewis Woolman reports the discovery of a third water-bearing horizon at Atlantic City, N. J. It is probable that these three horizons continue under the beaches South of Barnegat Inlet and beneath the Southern interior to a distance of 25 or 30 miles or more from the coast. The two upper ones have an intimate connection with a diatomaceous clay-bed, having a thickness of 300 feet. In view of the thickness and extent of the diatomaceous clay-bed in New Jersey, Mr. Woolman thinks its prolongation into the Southern Atlantic States should be expected, and that there is a strong probability that the outcrops on Chesapeake Bay near Annapolis, at Nomini Cliffs, and at Richmond, Va., are either identical with the New Jersey stratum or closely related to it and belonging to the same series (Annual Rept. N. J. Geol. Surv., 1890).

Prizes of the London Geological Society for 1891.—The medals and funds to be given at the anniversary meeting of the Geological Society on February 19, have been awarded as follows:—The Wollaston medal to Baron Ferdinand von Richthofen; the Murchison medal to Professor A. H. Green, F. R. S.; and the Lyell medal to Mr. George H. Moreton. The balance of the proceeds of the Wollaston Fund to Mr. O. A. Derby; that of the Murchison Fund to Mr. Beeby Thompson; that of the Lyell Fund to Mr. E. A. Walford and Mr. J. W. Gregory, and a portion of the Barlow-Jameson Fund to Prof. C. Mayer-Eymar. (Geol. Mag. Feb., 1892.)

Interval Between the Glacial Epochs.—In the Bull. Geol. Soc. Am., April, 1890, Mr. T. C. Chamberlin presents additional evidences bearing upon the interval between the Glacial Epochs; viz, that the early glacial plains are trenched by interglacial valleys. An examination of the lower Mississippi shows that the erosion amounts in round numbers to a trench about 300 feet in depth and about sixty miles in width. This erosion represents the interval between the formation of the silts of the earlier glacial epochs and the filling in of the valley deposits of the later glacial epochs. The upper Ohio and Allegheny, the Susquehanna, and the Delaware rivers have done a corresponding amount of work. The cutting of these trenches rudely measures the length of the interval between the glacial epochs, or at least the length of the actively erosive part of it.

Arkansas Geological Survey, 1890.—A report on Manganese, its Uses, Ores and Deposits,[1] by Dr. R. A. F. Penrose, Jr. has recently been published by the Arkansas Geological Survey. In order to ascertain the importance of the Arkansas deposits Dr. Penrose visited and personally examined every known manganese region in North America—those of Arkansas, Georgia, Tennessee, Virginia, Vermont, Texas, Arizona, Colorado, California, Oregon, Nevada, Utah, Nova Scotia and New Brunswick. The conclusions given in the report are therefore based upon direct personal observations, and are thoroughly trustworthy.

The author discusses (1) The uses of manganese, together with the history and statistics of the manganese industry; (2) The ores of manganese; (3) The nature of the manganese deposits. The chapter on the origin and chemical relations of manganese deposits is of special

[1] Annual Report Arkansas Geological Survey, 1890, vol. I. Manganese; Its Uses, Ores, and Deposits. By R. A. F. Penrose, Jr., Ph. D.

interest to the general reader. The sources of the metal, the forms and conditions of deposition and precipitation, and the geologic distribution, are given in a clear, concise and orderly way that shows a mastery of the subject.

The richest deposits in the United States are confined almost entirely to the Cambrian and Silurian rocks, while in Canada they are found in the Lower Carboniferous.

Dr. Penrose accounts for the variability in the quantity of ore, in different horizons, and in different places in the same horizon, by the conditions surrounding the deposition.

A geological map of the Batesville, Arkansas, region is folded in the pocket of the volume, and the text is still further illustrated by a number of figures and plates.

Geological Survey of Texas, 1890.[2]—The Second Annual Report of the State Geologist of Texas is a quarto of 756 pages, replete with information, valuable not only to the citizens of the state, but also to the geologists at large. The report of the State and Field Geologists are followed by an admirable series of papers which take up in detail a study of each formation with its various economic minerals and possibilities. Messrs. Dumble, Birkinbine, Lerche, Kennedy, Herndon and Walker report on the Iron Ore District of East Texas; Mr. Cummings gives the geology of the north-western part of the State; Mr. Comstock the geology and mineral resources of the central mineral region; and, finally, Mr. Streerowitz describes the geology and mineral resources of Trans-Pecos, Texas.

A separate chapter is given to a description, by Alpheus Hyatt, of the Carboniferous Cephalopods. These forms being extremely limited in their chronological distribution are helpful in distinguishing the age of the rocks in which they are found, and it was therefore decided to have them all published in one treatise.

The report is abundantly illustrated with plates, sections and maps, which add materially to its value and interest.

Geological News-General.—It is the opinion of Mr. Waldemar Lindgren that there exists in southern Lower California two orographic lines of great importance. (1) A comparatively recent, probably Post-cretacic line of dislocation extending from the vicinity of La Paz northward for many hundred miles along the eastern coast. (2) A

[2] Second Annual Report of the Geological Survey of Texas, 1890. E. T. Dumble, State Geologist.

line along which an uplift of much greater age than the first one has taken place, runs near the western shore of the peninsula. This line is indicated by several short ranges mostly composed of crystalline schists and granite. It is probable that the mesa sandstones have been derived from this older area by erosion. (Proceeds. Cal. Acad. Sci. vol. III. Pt. 1.)—Dr. Lydekker has recently published a summary of the present state of knowledge of the Fossil Birds found in Great Britain. He has embodied in this summary brief descriptions of typical specimens, pointing out some of the more striking features by which particular bones of certain groups may be recognized. The total number of species recorded in various collections is slightly over 60. This includes, however, birds of the superficial deposits, many of which belong to existing species; the list of extinct forms admitted as valid, falls short of 20.

Paleozoic.—Contributions to the Micro-Palæontology, Part III, has recently been published by the Geological Survey of Canada. It consists of a report on Ostracoda from the Cambro-Silurian, Silurian, and Devonian rocks at various localities in the Dominion by Prof. Rupert T. Jones, with a critical note on the species described by him in 1858. It contains forty-one pages of letter press, illustrated by four full page lithographic plates and five wood cuts.——W. B. Dwight has recently found a fossiliferous stratum of the Paradoxides zone at Stissing, New York. The species collected consists of *Leperditia ebenina*, *Kutorgina stissingensis*, *Olenoides stissingensis*, all undescribed, and a Hyolithes, probably "Billingsii."——Four new Silurian fossils have been described by Mr. Whiteaves; *Srophomena acanthoptera*, *Pentamerus decussatus*, *Gomphoceras parvulum*, and *Acidaspis perarmata*. The fossils are the characteristic ones of an area of Silurian rocks discovered by Mr. J. B. Tyrrell on the Northeast side of Lake Winnipegosis, on Cedar Lake, and on the Saskatchewan River below Cedar Lake. (Can. Rec. Sci., April, 1891.)

Cenozoic.—The frontlet and horn-cores of an antelope discovered by Dr. Leeson in the Plistocene deposits near Twickenham have been identified by A. Smith Woodward as those of *Saiga tatarica*. The remains of Saiga have been found in France and Belgium, but until now there has been no evidence of the occurrence of this animal in the British area. (Proceeds. Lond. Zool. Soc., Nov. 4, 1890.)—— The Geol. Survey of the United Kingdom has recently published a memoir by E. T. Newton embracing an account of all the Vertebrata

from the Pliocene deposits of Britain. The total number catalogued and discussed by the author is 212, of which 20 have evidently been derived from eocene rocks. After the elimination of derived and doubtful forms, about 142 definite species remain which have been tabulated as follows:

	Number of Species.	Occur also in Lower Beds.	Lived on to a Later Period.	Living Species.	Extinct Species.	Percentage of Living Forms.
Nodule bed below The Red Crag.....	68	—	20	6	62	8.8
Coralline Crag.....	15	8	8	5	10	—
Red Crag.....	6	5	5	3	3	—
Norwich Crag.....	21	10	12	5	16	—
Weybourn Crag...	7	5	6	5	2	—
Forest-bed.....	65	17	47	45	20	69.2

Mesozoic.—Mr. A. Smith Woodward has recognized three reptilian bones in a collection of vertebrate fossils from the Cretaceous formation of Bahia, Brazil. Two of the bones represent the articular end of a large Pterosaurian quadrate, while the third is a Plesiosaurian. The pterodactyle is the first of the kind in the Southern hemisphere, and the discovery of the Plesiosauri adds another important locality to the known distribution of that order. (Ann. & Mag. Nat. Hist., Oct., 1891.)——According to R. S. Tarr, the Permian of Texas in its most typical development was a completely enclosed sea. This is proved by the nature of its beds. In no other way can the numerous layers of gypsum and salt be accounted for. It would also explain the redness of the clays and sandstone beds. The peculiar sickly gray color of the limestone is that of an inland sea deposit, and the abundance of vertebrate fossils of both land and inland sea types is thus accounted for. The small break between the Carboniferous and the Permian shows that in point of time the formations were immediately associated, the marked difference in the nature of the beds, and the character of the fauna being due rather to changed conditions than to actual lapse of time. (Am. Journ. Science, Jan., 1892.)

MINERALOGY AND PETROGRAPHY.[1]

Petrographical News.—Several contributions to the subject of the origin of spherulites have recently been made by Messrs. Cross and Iddings, and one on the minerals occurring in hollow spherulites by the latter gentleman and Penfield. Iddings[2] distinguishes two kinds of spherulites; one composed of radial fibres forming the compact spherulite; and the second consisting of jointed and branching fibres of feldspar, separated by tridymite scales and gas cavities. Gradations between small, dense spherulites composed of micro-felsite, and large ones, the nature of whose structure can be determined, were traced in many instances, and from them the conclusion is reached that microfelsite is in many cases but a microscopic intergrowth of feldspars, elongated parallel to the clino-axis, and quartz, and that the spherulites are but special phases of granophyric growths. The discovery of tourmaline and mica, especially near the margins of spherulites, is an additional proof of the correctness of Iddings' view that spherulites are the result of crystallization of pasty rhyolitic magma under the influence of moisture. These two minerals are younger than the smaller compact radial spherulites of the rock, and older than the final crystallization of the residual magma between the spherulites. In the porous spherulites with branching fibres, or the lityophysae, some of the fibres are negative and others positive in the nature of their double refraction; that is, some are orthoclase crystals elongated parallel to *c*, with the plane of the optical axes normal to the plane of symmetry, and others are elongated parallel to *a*, with the plane of the optical axes in the plane of symmetry. The essential characteristic of spherulitic growth is the internal structure of the spherulites. They are not made up of amorphous substances under a strain, but of definitely crystallized minerals arranged radially with one or several centres of crystallization. Under this head, according to the author, would fall granophyric intergrowths, which are radially branching aggregates of orthoclase and quartz. Cross[3] places emphasis on the valuelessness of the term microfelsite in petrographical nomenclature, as he finds the material to be an aggregate of quartz and orthoclase, two definite minerals, and not the ill-defined substance described by Rosenbusch. He attacks both Rosenbusch's and Levy's classification of spherulites as incapable of covering the handsome bodies found by himself in the

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2] *Bull. Phil. Soc.*, Washington, xi, p. 445.

[3] Ibid, xi, p. 411.

rhyolites of the Silver-Cliff-Rosita mining district in Custer County, Colorado, where spherulites occur of all sizes, up to ten feet in diameter. All are products of the consolidation of a magma, whose composition is *

SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	H_2O
71.56	13.10	.61	.28	.16	.74	.14	4.06	3.77	5.52

or about $\frac{2}{3}$ alkaline feldspar and $\frac{1}{3}$ free silica, from which nearly all of the Ca, Mg, etc., had been separated as phenocrysts of plagioclase before the formation of the spherulites. The oldest of the spherulites are minute bodies, in some of which a granophyric growth is detectable. The large ones are found in many generations. Some contain internal cavities, while others are compact. The hollow spherulites are composed of radiating branching orthoclases, with opal and other forms of silica between the fibres, forming a mass through which are scattered minute balls of tridymite or grains of quartz. Another type of spherulite is the trichitic, in which the feldspars are branched and curved to an unusual degree, forming a radiating bunch parallel to whose radii trichites of magnetite are arranged. Both hollow and trichitic spherulites are often surrounded by a supplemental growth in which the feldspar is in very delicate needles. The various generations of spherulites locally make up the entire rock, but usually there is a little residual material consisting of glass, of another radiate growth, or of a combination of both. Compound spherulites are composed of regular orientations of successive growths. The many spherulites of quartz that have been described are thought by the author to be largely feldspar and quartz aggregates, in which the orthoclase is elongated parallel to *c* with the abnormal optical orientation, and thus have a positive double refraction, when they are with difficulty distinguished from quartz microlites. Cross has traced unmistakable prismatic orthoclase down into fibres, and so seems warranted in stating that determinations of the character of the material of spherulites based entirely on the character of the double refraction of the fibres are worthless. Some of the spherulites of the Colorado occurrence consist entirely of positive feldspar, while others are composed of mixtures of this with a negative variety. With reference to the origin of spherulites, Cross reaches the same conclusion as that reached by Iddings; the mass in which spherulitic growth was set up must have come to rest and consequently must have been pasty, since fluidal lines cross the spherulites undisturbed in their courses. During the formation of some of the spherulites the mass again became pasty, and in

certain areas became colloidal, then rapid crystallization was set up and the branching forms resulted.——Though the main features of the Rapakiwi granite have long been well-known through the descriptions of Ungern-Sternberg, but little information has been granted us as to its occurrence and structural peculiarities. A recent article by Sederholm[4] gives an account of the varieties of the rock and outlines their modes of occurrence. The peculiarity common to all varieties is the occurrence of porphyritic crystals and the possession of a granophyric ground mass. The prevailing type possesses phenocrysts having an elliptical form and surrounded by a rim of oligoclase. The orthoclase is never pure, but it contains plagioclase particles and grains of quartz, and biotite or hornblende, the usual constituents of the ground mass. These inclusions are often arranged concentrically. The peculiarity of the structure of the ground mass is the idiomorphism of the quartz, which is often intergrown with the feldspar, lepidomelane and hornblende in micropegmatitic forms. The place of the orthoclase phenocrysts is sometimes taken by an aggregate of orthoclase and quartz grains, surrounded by a radiating rim of orthoclase and an exterior one of plagioclase. Miarolitic cavities are filled with fluorite. As the orthoclase becomes smaller the structure of the rock becomes more granitic, at the same time the amount of orthoclase decreases and microcline takes its place. The finest grained varieties occur as dykes in the others, and are finely granophyric. All these varieties occur in the Wiborg district in South Finland, where, on account of their remarkably easy weathering and the consequent production of granitic debris, they are well known. This easy weathering is ascribed by the author to mechanical rather than chemical agencies. At Åland and other regions types are found resembling more or less closely those described. In some porphyritic crystals of oligoclase occur in a micropegmatitic ground mass of quartz and orthoclase, and in others porphyritic quartzes in a granophyric ground mass. Between the branches of the quartz in the granophyre are small areas of coarse grain, and in these are found the miarolitic cavities. Not only do the rocks described occur in Southern Finland, but they are found also in the Southwestern portion of the same country, as well as on the islands off its coast and in the Eastern part of Sweden. All the varieties are supposed to be phases of the same magma, the coarse-grained, deep-seated facies and the granophyric surface forms. For granitic rocks with idiomorphic quartz the author proposes to use the descriptive

[4]Min. u. Petrog. Mitth., xii, p. 1.

term *anoterite*, because probably found at a less depth than the true granite. All the Rapakiwi rocks are thought to be post-archean, but not older than early Cambrian. Structurally they are supposed to represent the source of great radiating dykes and flows (Taphrolites). ——Among some rocks obtained by Doelter from the Cape Verde Islands, Eigel[5] has discovered an augite-diorite, augite-syenite, nepheline basalt, and two doubtful types, which he places respectively with the teschnites and phonolites. The augite-diorite consists of orthoclase in well-formed crystals, and gray plagioclase in lath-shaped individuals, and irregular grains of augite and hornblende. The nepheline basalt occurs as dykes in the diorite, and is composed of phenocrysts of augite and plagioclase, a few olivines and probably orthoclase in a ground mass of nepheline, plagioclase and grains of augite and hornblende. The rocks to which the author assigns a place with the teschnites consist in large part of a ground mass of altered anorthite and orthoclase, in which are brown augite and hornblende, both altered on their edges to dilorite, a little biotite, magnetite and apatite. The composition of one of these is given as:

SiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	K_2O	Na_2O	H_2O
39.64	16.98	6.61	9.31	10.58	6.65	3.09	5.95	1.32

The phonolites are fine-grained rocks, made up of porphyritic crystals of acmite and red augite, sometimes zonally intergrown, and hornblende, in a ground mass consisting of microlites of hornblende, augite, biotite, orthoclase, plagioclase, muscovite and magnetite, and little grains of a colorless mineral, probably orthoclase, in an isotropic base. Nepheline could not be detected microscopically, but is supposed to be present as the result of chemical tests. One specimen contains regularly outlined icositetrahedra composed of a nucleus of calcite and sahlite, and an external zone of biotite, that are regarded as altered garnets. Since this rock occurs between a well characterized phonolite and limestone it is thought to be a contact facies of the former.

The trachytes, andesites, basalts, etc. of the Upper Eifel have been subjected to a very careful investigation by Vogelsang.[6] The phonolite and the leucite and nepheline basanites have no peculiar characteristics which need be referred to here. The basalts include plagioclase, leucite and nepheline varieties, the former two of which have effected alteration in sandstones and graywackes, with which they are in contact. The trachytes are very much like the Drachenfels rock,

[5] *Mineralog. u. Petrog. Mitth.*, 1890, xii, p. 91.
[6] *Zeit. d. d. geol. Gesell.*, xliii, 1890, p. 1.

and like some specimens of this, contains tridymite in its ground mass. The most interesting type studied is hornblende andesite. This also contains tridymite in its ground mass, and also contains parallel growths of biotite and hornblende with OP of the former parallel to $\infty P\bar{\infty}$ of the latter. The hornblende is much corroded, and new hornblende and feldspar are among the products of its solution. Large numbers of concretions are characteristic of the rock. There are granular aggregates of cordierite, andalusite, sillimanite, feldspar, biotite, pleonast, corundum, rutile, quartz, garnet, zircon and magnetite, and are sometimes schistose. The author thinks that they were originally inclusions of sillimanite-cordierite gneiss or schist that were altered by contact with the molten mass of the andesite. He strengthens his supposition by treating cordierite-sillimanite rocks with andesite material, when he obtains an abundance of pleonast, which is one of the most characteristic minerals of the aggregates.——The leucitophyres of the Laacher-See region have again been subjected to a very thorough microscopical study. Martin[7] has found them to consist principally of sanidine, leucite, nepheline, augite, and sometimes biotite and melanite phenocrysts in a ground mass of sanidine, nepheline and green augite, together with a little glassy base. He regards them as tertiary in age and separates them into two groups, according to the presence or absence of melanite. The former contain but 48.50–49.25% of SiO_2, while in the latter the percentage of this constituent rises to 53–54%. The mineral in the rock from Perlerkopf, thought by Rosenbusch to be perofskite, is melanite. The rocks from Seeberg, called trachyte by Zickel, are phonolites containing green and violet augite and nests of olivine. There appear to be gradations between the phonolites and fasanites. The leucite-tufa of the region is a leucitophyre-tuff and the leucitophyre-nepheline tephrites and nephelinites of the Harmebacher Ley are all nephelinites. Some of Selberg are feldspathic basalts and nepheline basalts, the latter with leucite crystals altered to zeolites and augites filled with hornblende inclusions.

At Democrat Hill and Mt. Robinson in the Rosita Hills, Col., are two vents of old solfataras, whose gases have so affected the rhyolite surrounding them that two entirely new and unique rocks have resulted. At the former place the original rhyolite is now replaced according to Mr. Cross[8] by a cellular rock composed of alunite and quartz, and sometimes a little kaolin, whose cavities are lined with

[7] *Zeit. d. d. geol. Gesell.*, xlii, p. 151.

[8] *Amer. Jour. Sci.*, June, 1891, p. 466,

crystals of the first two minerals. The alunite is tabular and has a composition:

SiO_2	Al_2O_3	K_2O	Na_2O	SO_3	H_2O	Fe_2O_3, etc.
65.94	12.95	2.32	1.19	12.47	4.47	.55

At Mt. Robinson the alunite rock is not quite so regular in character, since it contains in places little tablets of barite. Toward the West of the ridge on the top of the mountain is another unique rock composed almost entirely of quartz and diaspore. The composition of this rock is as follows:

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	CaO	Alk	SO_3	P_2O_5	H_2O
76.22	.11	19.45	tr.	tr.	tr.	.29	.13	3.82

An analysis of the diaspore crystals implanted on the walls of its cavities yielded $Al_2O_3 = 83.97$; $H_2O = 15.43$.——Among the Archean schists of the Argentine Republic Kühn[9] finds gneisses, mica schists, quartzite and phyllite. In the last three rocks but little of special interest was noted except in the case of the quartzite, where cordierite is supposed to have been discovered. The gneisses are divided into biotitic, muscovitic, and granulitic varieties, and a variety containing two micas. Each group contains fine and medium grained kinds, and one—the biolitic group— embraces a series of "augen-gneiss." The eyes are feldspars, whose outlines indicate that they were originally phenocrysts in a porphyritic granite. Fractured crystal components, peripheral granulation of some of its constituents and an undulous extinction in others, all indicate that the rock has been subjected to enormous pressure. In connection with the discussion as to its origin the author gives an account of the views held on the subject of the origin of gneisses, and discusses their probable correctness. He concludes that gneisses produced by pressure became schistose after their constituents had formed, and that their schistosity is a direct result of the plasticity of the rock mass under pressure, and is not a consequence of numerous fracturings and re-cementings, as Lehmann would have us suppose. With reference to the chemical changes produced by dynamo-metamorphism the author gives descriptions of the alteration of garnet into biotite, and of tourmaline into pinite. He also gives an account of the weathering of garnet into hornblende, and of biotite into chlorite and epidote. The article is particularly interesting in its treatment of the characteristics of schistosity and the origin of the schistose structure.——The constituents of the pegmatite veins

[9] *Neues Jahrb. f. Min.* etc.; B. B. vii, p. 295.

cutting the crystalline schists and granites of the Western part of the Argentine Republic have been carefully examined by Sabensky.[10] They are aggregates of orthoclase, microline, quartz and mica, with plagioclase, biotite, chlorite, tourmaline, garnet, beryl, apatite, zircon and hematite as accessory components. Both the potassium feldspars are intergrown with albite lamellæ, inlaid parallel to a plane between $\infty P_{\overline{\infty}}$ and $2P_{\overline{\infty}}$. The microline offered a fine opportunity for the study of its characteristics. An untwinned specimen gave as a mean of the measurements of its cleavage faces the angles 89° 30.6′ and 90° 29.4′. The peculiar grid-iron structure seen in certain thin sections of the minerals are ascribed to twinning according to the albite law, and not to a combination of twins according to the albite and pericline laws. The arguments brought forward in support of this view are too involved to be dealt with in this place. They are clearly stated in the author's article. Gas and fluid inclusions were formed in the quartz, which mineral often possesses an undulous extinction. Quartz and feldspar are frequently intergrown to give rise to the graphic structure. This is explained by the author as a regular intergrowth of the two minerals in a manner analogous to that of orthoclase and albite, *i. e.*, the quartz follows easy cleavage planes in the feldspar.

Mineralogical News.—Of some rare Argentine minerals recently described by Klockmann[11] the following deserve notice: *Eukarite*, *Umangite* and *Luzonite*. The first named is regarded by the author as a member of the galena group, in spite of the fact that it appears to possess a foliated structure and an hexagonal habit. One analysis yielded: Ag = 43.13; Cu = 25.32: Se = 31.55, corresponding to Ag, Cu, Se, or a jolpaite in which Se replaces S. The mineral occurs in a vein with calcite and umangite, cutting a limestone of unknown age. The *umangite* has heretofore been mistaken for barite. An analysis of the purest material obtainable gave: Cu = 56.03; Ag = 49; Se = 41.44; Co_2, H_2O, etc., = 2.04, which corrected for impurities gives a result corresponding to $Cu_3 Se_2$. Its density is 5.620. The mineral, which is new, is found massive and in the form of a very full-grained granular aggregate. Its hardness is 3. It has a metallic lustre and is opaque. Its streak is black, while its color in consequence of corrosion is a dark, cherry red or violet. The name is taken from the locality in which it occurs—on the West slope of the Sierra de

[10] *Neues Jahrb. fur Min.*, etc., B. B. vii, p. 359.
[11] *Zeits. f. Kryst*, xix, 1891, p. 265.

Umango, La Rioja. *Luzonite* was described by Weisbach from Luzon, Philippine Islands, as a substance in all probability isomorphous with famatinite. It however has the composition of enargite, which according to Stelzner is not isomorphous with famatinite. Klockmann thinks the latter mineral and luzonite isomorphous, and regards luzonite as the dimorphous form of enargite. The luzonite is associated with barite as a reddish gray or light copper-red, massive substance with a hardness of 3.5 and a density 4.390. Its composition is Cu = 47.36; I = 32.40; As = 16.94; Sb = 3.08. The locality given for it is Sierra de Famatina, La Rioja.——Analyses of *astrophyllite* from the cryolite locality at St. Peter's Dome, Colo., and of *tscheffkinite* from Bedford Co., Va., yielded Eakins[12] respectively:

Ta_2O_5	SiO_2	TiO_2	LrO_2	$ThO(YEr)_2O_3$	$(LaDi)_2O_3$	Ce_2O_3	Al_2O_3	Fe_2O_3	FeO	MnO
.34	35.23	11.40	1.21				tr.	3.73	29.02	5.52
.08	20.21	18.78	tr(?)	.85	1.82	19.72	20.05	3.60	1.88	6.91

CaO	MgO	K_2O	Na_2O	H_2O	Sp.Gr.	
.22	.13	5.42	3.63	4.18		$R_4''\ R_4'\ Si(SiO_4)_4$
4.05	.55		.06	.94	4.33	

The astrophyllite was very pure, so that the figures of the analysis must be regarded as representing accurately the composition of the substance, especially since they correspond so closely to the formula suggested by Brögger as the result of Bäckstroms investigation. The tscheffkinite was somewhat altered. In thin section Mr. Cross found a brownish transparent amorphous substance crossed by cracks containing reddish brown ochreous decomposition products and bands of colorless minerals that appear to be calcite and sphene, besides several darker minerals. The material analyzed by Price[13] was found upon examination to be as complex in composition, so that it seems probable that the substance has no place among minerals.——The *kamacite*, *tænite* and *plessite* found in the Welland meteorite[14] were so easily separable that Davidson[15] has succeeded in obtaining a sufficient quantity of each for analyses. The kamacite is brittle and of the color of cast iron, while tænite is silvery in lustre and is flexible. The results of the analyses are as follows:

	Fe	Ni	Co	C
Kamacite . .	93.09	6.69	.25	.02
Tænite . .	74.78	24.32	.33	.50

[12] *Amer. Jour. Sci.*, July, 1891, p. 34.
[13] *Amer. Chem. Jour.*, Jan. 1888, p. 38.
[14] *Howell. Proc. Rochester Ac. Sci.*, 1890, p. 86.
[15] ib., p. 64.

Both are magnetic, the latter evincing stronger polarity than the former. In etching the kamacite is attacked more rapidly than the richer alloy of nickel. Plessite was found to consist of fine lamellae of the two alloys above mentioned.——Brown[16] has carefully examined the *bernardinite* first described by J. M. Silliman,[17] from San Bernardino Co., Cal., as a new mineral resin, and has discovered it to be in all probability the fungus *Polyporus officinalis.*——Weed finds[18] that the ore deposit of the Mount Morgan gold mine in Queensland, Australia, is a siliceous sinter like that of the Yellowstone National Park, impregnated with auriferous hematite. Both the sinter and the hematite are clearly hot spring deposits. A brief abstract of a paper read by Dr. Foote[19] at the Washington meeting of the A. A. A. S., gives an account of the discovery of black and colorless *diamonds* in a fragment of meteoric iron weighing forty pounds found at Crater Mt., about two hundred miles North of Tucson, Ariz. The diamonds usually occur associated with amorphous carbon in the cavities in the mass, which contains about 3% of Ni.——Census Bulletin No. 49, by Mr. Kunz[20] contains a brief account of the value of gems and precious stones discovered and worked up in the United States during the year 1889. The total value of the materials found within the country amounted to $188,807. Agatized wood, turquoise, zircon, and quartz in the order mentioned are the most important domestic productions falling under the head of precious stones used as ornaments or gems.

[16] *Amer. Jour. Sci.*, July, 1891, p. 46.

[17] ib., xviii, p. 57.

[18] ib., Aug., 1891, p. 166.

[19] *Scientific American*, N. Y., Aug. 29, 1891, and *Amer. Jour. Sci.*, Nov., 1891, p.

[20] Census Bulletin No 49, April 14, 1891.

ZOOLOGY.

The Nervous System of Echinoderms.—The recent work of Jean Demoor and Marcellin Chapeaux on the nervous system of the *Asteracanthion rubens* is embodied in a paper published in Tidsch. Nederland. Dierk. Vereen, II Serie vol. iii. The subject is treated both from an anatomical and physiological point of view. It includes also a systematic account of the effect of poisons and of heat upon *Asteracanthion rubens.* The authors sum up their conclusions as follows:

"The nervous system of the star-fish is differentiated into two systems, the condensed and the diffused, between which however, one finds it difficult to draw a sharp distinction. The functions are however now specialized in this large group, for we have shown that the two nervous fields have a distinct and peculiar functional aspect. Each presenting a distinct activity, they divide between themselves the work which is appropriate to the life of relation. Owing to the close connection which exists between them, the two systems can aid each other and work together for the accomplishment of the multiple manifestations induced by the different conditions external and internal, by the sensations arising from stimuli, and by reaction. To the diffused nervous system is attributed above all the role of perception and of sensation. It is the one that gives the organism a notion of its position and which informs it of its state of equilibrium. It is the one also which accumulating those diverse and vague organic impressions, which the physiologist groups under the name "kynetic," keeps the animal in constant activity and readiness to respond to stimuli.

"The motive impulses, properly speaking, the external manifestations of vital phenomena do not depend directly upon the diffused system. Their real centre is the condensed system which must then be the true organ of reactionary impulses. It is the centre in which are generated the reflex motions; it contains cell groups whose functions are definitely specialized, and which thus form the first traces of a more advanced type in which the different important manifestations of activity have become localized in distinct regions. The two nervous systems are intimately connected. The innumerable relations which unite them render their functional agreements close and each reinforces the other. From this last point of view a progressive specialization is also manifested. In fact, the conduction of excitations causing the

ordinary sensations which are important only in the aggregate, is accomplished by means of the hidden fibrillæ which unite the condensed with the diffused system. On the contrary, some ways of direct communication between the two systems have been established physiologically for the special excitations before provoking a quick response, necessary and fatal. The easy propagation of the sensations thus allows the corresponding motor centers to readily respond."

The Land Molluscan Fauna of British New Guinea.—Last year Mr. C. Hedley had an opportunity of collecting and studying the land shells of this little-known region and has embodied the results in a paper published in the Proceeds. Linn. Soc. vol. vi. The author states that for the convenience of students he gives in his paper a summary of the knowledge of this fauna up to date.

The land shells of this province exhibit four rather distinct geographical divisions:

(a) The alpine fauna, whose sole known member is *Rhytida globosa.*

(b) The region lying between Port Moresby and the Fly River. The types in this region are *Hadra broadbentii, Geotrochus tayloriana* and *Helecina coxenii.* Mr. Hedley believes that the tropical Mollusca of Queensland were probably derived from this fauna, by migration across the dry bed of Torres Straits.

(c) A province which includes the eastern extremity of New Guinea with the outlying islands, of which the typical members are *Hadra rehseii, Nanina bunsteinii,* and *Geotrochus brumeriensis.*

(d) The Louisiade, D'entrecasteaux, Trobriand, and Woodlark Archipelagos. Characteristic forms are the Geotrochi allied to *louisiadensis* and the gigantic Pupinellæ allied to *grandis.* The author thinks that the occurence of *G. welsianus* and *P. brazierœ* on Fergusson Is. would indicate that the fauna of these islands will prove to be related to that of the distant Louisiades rather than to that of the nearer mainland.

Of the 110 species described by Mr. Hedley, 25 are new, and have been carefully figured, many of them magnified, to assist in identification.

The Pycnogonid Eye.—Mr. T. H. Morgan has been studying the structure and development of the eyes of Pycnogonids, and he sums up the results as follows:

"I believe all the layers of the Pycnogonid eye give abundant evidence that the eye has developed by the turning in of two sides of a primitive optic vesicle, and that the simple eyes of insects furnish all

the intermediate stages, both in development and adult structure, between a simple cup-like invagination and the three layered condition of the Pycnogonid eye.

"I am inclined to push this a step further and attempt to show that the median Arachnid eyes have developed along a similar path, and this must be a necessary corollary to the position to which I have assigned the Pycnogonids, and believe, that the inversion of the Spider's eye in its Pycnogonid stage of evolution and the righting of it a secondary and later change. I also believe there is no evidence that in the evolution of the Spider's eye a change of position in the lens has taken place." (Studies Biol. Lab. Johns Hopkins Univ. vol. v. No. 1.)

Lateral Sense-Organs of Elasmobranchs.—At the meeting of the Royal Society of Edinburgh, Dec. 21, 1891, Prof. Corsar Ewart read the second part of a paper written by himself and J. C. Mitchell, on the lateral sense-organs of Elasmobranchs. In this part the authors deal with the sensory canals in *Raia batis*. It has been supposed that these canals serve for the production of mucus. The authors consider that this idea must be abandoned. They have observed a number of mucus glands in the skin sufficient to account for all the mucus found on the surface. They incline to the opinion that the canals have some respiratory functions. (Nature, Jan. 7, 1892.)

South American Siluroids.—G. A. Boulenger has published (Proc. Zool. Soc. Lond. April, 1891) an account of the Siluroid Fishes obtained by Dr. von Ihering and Mr. Wolff in Rio Grande do Sul, Brazil. The following is a list of the new species added to the Brazilian fauna: *Pimelodella eigenmanni* n. sp. n. for *P. buckleyi* E. & E. not Boulenger. 2, *Pseudopimelodus cottoides*, 3, *Otocinclus nigricauda*, 4, *Bunocephalus iheringii*, 5, *Trichomycterus minutus*.

Bunocephalus iheringii is interesting from the fact that no other species of the Aspredinidæ have so far been found south of the Amazons.—C. E. Eigenmann.

The Spermatophores of Diemyctylus.—The fertilization of the Urodela has been until lately very imperfectly understood. The recent observation of Gasco and Zellu on European forms, and Gage's studies of Diemyctylus have proved beyond a doubt that fertilization is internal, but there is no direct cloacal contact between the sexes.

If a female newt be examined during the months of May and June spermatozoa will be found in the cloaca, not inside the mouth of the oviduct as might be expected, but closely packed in the ducts of two groups of gland-like structures situated in the cloacal wall just below the entrance of the oviducts. The question as to how the spermatozoa find their way to these snug resting-places is an interesting one. According to Mr. E. O. Jordan the explanation lies in what Pfeffer calls "positive chemotaxis." He thinks it probable that the pelvic glands of the female newt may secrete a substance—proteid or otherwise—with a positively chemotactic effect and thus draw the spermatozoa into its ducts.

During copulation both animals are motionless, sometimes for hours, with the exception of a fanning movement of the tail by the male, which is sometimes repeated by his mate. From this position the male passes gradually into a more violent stage, which has been wrongly stated by some authors to extend over the whole period. At the climax of agitation the male leaves the female, and with his tail slightly raised, his cloaca widely distended with numerous white protruding papillæ, waits for the female to follow him. If she does this and presses her head lightly against the cloacal region, the male deposits a spermatophore and then creeps on to a distance of a few centimeters, where, if the female still continues to follow him, he deposits another. Three is the number generally discharged.

"The spermatophore consists" to quote Mr. Jordan, "of three parts: a thick, irregular mass about six millimeters in diameter which adheres to the bottom of the aquarium; a tough elastic spine projecting upwards from the base; and, borne on this spine, an approximately spherical mass of spermatozoa about one and one-half millimeters in diameter, this mass being a sort of concretion of small balls of spermatozoa."

After the male has deposited the first spermatophore he moves forward with the female following him. In so doing she naturally brushes over the spermatophore and the mass of spermatozoa adheres to the cloacal lips and passes thence into the cloacal chamber. The chance of the spermatophore's fulfilling its mission is about 1 to 4.

It is difficult to understand why the spermatozoa choose to pass into the female cloaca rather than into the surrounding water unless a positively chemotactic influence is supposed. It is possible that the pointed spine in Diemyctylus may play an important part in the transaction. The elastic spine easily bent down by the female passing over it, and as easily springing up when the entrance of the cloaca is

reached would seem adapted for effecting the entrance of the spermatozoa; but this is not the invariable mode of entrance. It more frequently happens that the spermatozoa are deposited on the cloacal lips and the surrounding skin so that the final conclusion of Mr. Jordan is that as in the European form reported by Zellu "the spermatozoa find their way to the 'Samentaschen' by virtue of their own activity." (Journ. Morph. vol. v., No. 2.)

A New Species of Wandering Albatross.—Sir Walter Buller has lately had an opportunity of examining sixteen examples of a supposed new bird, collected on the Aukland Islands and off the New Zealand coast, and has no hesitation in declaring it to be a distinct species, readily distinguishable from *Diomedea exulans* by its larger size, by its perfectly white head and neck from the nest to maturity, and by its having the bare eyelids jet-black, at all ages. This albatross being the noblest of the whole group, he selects for it the distinctive specific name of *Diomedea regia*. It nests earlier than *D. exulans*, actually hatching out its young in the Aukland Islands whilst the other species is only preparing to lay. (New Zealand Journ. Sci. 1891.)

The Temperature of the Dog.—Dr. Wesley Mills has been investigating the subject and has published the following results in Forest and Stream Jan. 28, 1892.

Range of temperature for the twenty-four hours.

Greyhound Dog (Two years old.)		Gordon Setter Bitch (About the same age.)	
Hours.	Temp. in degrees F.	Hours.	Temp. in degrees F.
10.00 A. M.	102.0	10.00 A. M.	101.4
12.00 M.	102.2	12.00 A. M.	102.2
2.00 P. M.	102.4	2.00 P. M.	101.7
5.30 P. M.	101.7	5.30 P. M.	101.9
8.15 P. M.	101.5	8.15 P. M.	101.6
10.30 P. M.	101.5	10.30 P. M.	101.6
12.00 P. M.	101.4	12.00 P. M.	101.2
2.00 A. M.	101.4	2.00 A. M.	100.8
4.00 A. M.	100.4	4.00 A. M.	100.7
6.00 A. M.	100.4	6.00 A. M.	100.8
7.40 A. M.	100.6	7.40 A. M.	100.5

The temperature was taken in the rectum in each instance for ten minutes. As the experiments were intended to be scientifically accurate, a self-registering thermometer with a Kew certificate testifying that the instrument was strictly accurate, was used. Such a one costs three dollars, but for ordinary work a good instrument can be secured at a lower price; nevertheless it does not pay to buy a cheap instrument.

The next table is the consecutive temperatures in one day for a Great Dane Bitch, eight months old.

Hours.	Deg. F.	Hours.	Deg. F.
8.30 A. M.	102.8	6.15 P. M.	101.7
10.00 A. M.	101.9	8.00 P. M.	101.1
2.00 P. M.	101.3	10.00 P. M.	100.5
4.15 P. M.	101.5		

It will be seen in this case the temperature in one instance reached almost 103 degrees.

The temperature in puppies is rather higher and decidedly more variable than in grown dogs. The following table for two English setter puppies of the same litter, nine months old, illustrates this less than it does the variations for the same breed and individual kept under precisely the same conditions:

Hours.	Temp. in degrees F.	Hours.	Temp. in degrees F.
8.30 A. M.	102.2	8.30 A. M.	102.5
11.00 A. M.	102.6	11.00 A. M.	102.4
2.00 P. M.	102.7	2.00 P. M.	102.5
5.00 P. M.	101.7	5.00 P. M.	101.9
7.00 P. M.	101.9	7.00 P. M.	101.9
9.00 P. M.	102.2	9.00 P. M.	101.6

It will be noted that the temperature in the case of one of these puppies reached 102 degrees, or higher, four times in twelve hours.

Zoological News.—Mollusca.—According to J. G. Cooper, the peninsula of Lower California has as yet yielded but 24 species of terrestrial Mollusca, 3 of which are Californian, while the rest belong to tropical groups but are in general peculiar to the peninsula. A curious fact to be noted is that 2 of the species occur in the similar arid regions of western South America and nowhere in the intervening moist regions. (Proceeds. Cal. Acad. Science, vol. iii., p. 1.)

Arthropoda.—Mr. Arthur Dendy has recorded observations that go to show that *Peripatus leuckartii* is oviparous. It lays its eggs in July and the young are hatched at the end of October. This is a singular departure from the habit of members of this genus, since in all the other species of Peripatus whose life-history is known the young are born alive. (Zool. Anz. Dec. 1891.)—According to W. W. Smith, *Pompilus fugax*, *P. monachus*, and *P. carbonarius*, the spider-hunting wasps of New Zealand, are never at a loss for food in their native land. The former, unlike many indigenous Hymenoptera, is slowly increasing in numbers owing to the abundant food supply.—(New Zeal. Journ. Sci. No. 3, vol. I.) **Vertebrata.**—The Congo Collection of fishes in the Zool. Mus. of Utrecht has been examined by L. Schilthins who thinks he is justified in regarding ten species and one genus as new to science. Descriptions, with figures of these novelties are published in Tidsc. Nederland. Dierk. Vereeing, 2d Serie, Deel III.—C. H. and R. Eigenmann report an addition of 21 species, 11 of which are new to the ichthyological fauna of San Diego. (Proceeds. Cal. Acad. Sci. vol. iii., Pt. 1.)—According to Mr. A. Butler the Carolina Parrakeet (*Conurus carolinensis,*) whose range is now confined to quite restricted areas in some of our Southern States, was formerly known as a characteristic bird of Indiana. At the time of its greatest range in that State, within historic times, it was known from New York, Pennsylvania and Maryland to Kansas, Nebraska, and possibly Colorado. (Auk. vol. ix., Jan., 1892.)—A series of tortoises found in Key West prove upon examination by Mr. Garman to belong with a specimen from Cuba described by him in 1887 to which only a generic name was attached. This tortoise is closely related to *Cinosterinum pennsylvanicum* and has been given the name of *C. baurii.*—M. C. Judson Herrick has recently published a paper entitled, Studies in the Topography of the Rodent Brain. The types chosen for these studies were *Erethizon dorsatus* and *Geomys bursarius*, partly because they seem to be aberrant members of the rodent stock and present striking peculiarities both in habits and general structure. *Erethizon dorsatus* is the only North American representative of the Hystricidæ. *Geomys bursarius*, the "pocket gopher" of the West, is widely separated from the other Myomorpha by its fossorial and nocturnal habit and the peculiarities of structure resulting from it. The paper is prefaced by one containing an interesting account of the habits of the Rodents under discussion together with those of the Muskrat (*Fiber zibethicus*), and some points in their anatomy more or less bearing directly upon their anatomy. (Bull. Sci. Lab. Dennison Univ. vol. vi. Pt. 1.)

EMBRYOLOGY.[1]

Epigenesis or Evolution?[2]—One part of this paper is devoted to the results of certain experiments upon the action of light upon the cleavage of eggs. These show that the eggs of *Echinus microtuberculatus, Planorbis carinatus?* and *Rana esculenta* undergo cleavage and the early stages of organ formation equally well in darkness, white light or colored light. Light then has no effect upon the early stages of development, though others have shown that the presence or absence as well as the color of light does have an effect upon the later stages of differentiation of embryos.

The main portion of the paper, however, contains the most interesting results: that from one of the first two blastomeres of the egg of *Echinus microtuberculatus*, and the same is true of a species of *Sphærechinus*, a complete pluteus of normal form but of half the normal size may be reared!

Owing to the importance of these experiments as bearing upon the value of the blastomeres upon the question of early potential reparation of organs within the egg, that is, upon the question of evolution as opposed to epigenesis, it will be necessary to give here a brief account of the author's methods, from which the chance of error may be deduced.

When the first cleavage furrow has come in, 50–100 eggs are shaken vigorously for five minutes, with little water in a test tube 4 cm. long and 0·6 cm. wide, then quickly poured into clean sea water and examined. If the right moment has been taken, neither too soon nor too late, some of the blastomeres will be found not only isolated but still alive, others of course dead, or not separated from their fellows as the egg membrane does not always burst open. There is also great variations in the resistance offered by eggs of different individuals—some may need to be shaken several times.

The best isolated cells are removed and placed two or three together in sea water in solid watch glasses covered, and with a hanging drop on the cover to diminish evaporation and concentration of the sea water. In these glasses the embryos develop and were observed from time to time without removal.

[1] Edited by Dr. T. H. Morgan, Bryn Mawr College, Bryn Mawr Penn.

[2] Hans Driesch: Entwick lungs mechanische Studien. Zeit. f. wis. Zool. liii, Nov., 1891.

The normal cleavage as shown by Selenka is accomplished as follows: two meridional furrows followed by an equatorial make eight equal cells, four of which bud out four little cells at one pole while the other four divide. There is thus a stage with 16 cells, marked by 4 small ones at one pole: these remain evident during the 28, 32, 60, 108 cell stages.

Now in the great majority of artificially isolated single blastospheres the cleavage results in the formation of a half blastula. The single cell divides into 2 and then in 4 equal cells: then the two upper cells bud off two small cells while the two lower cells divide, forming then 8 cells arranged just like one-half of the normal 16 cell stage. The time taken for the half-egg to reach the 8 cell stage is the same as for the whole egg to reach the 16 cell stage.

Though in the majority of cases the evening of the first day saw half blastulas formed from the half-eggs, there were also present certain cases in which from the first or from later stages of cleavage the half-egg formed a symmetrical though small sphere, not a half sphere.

The next morning revealed actively swimming complete blastulæ formed from the half blastulæ, though of small size, yet normal. How the half sphere closed in was not observed. As they are only one-half the normal size yet have cells of the normal size the number of cells must be one-half the normal. Whatever the mode of closure of the half-sphere may be, its occurence shows that the half-egg is able to furnish a complete individual, both right and left, anterior and posterior, dorsal and ventral parts, and had not given up part of this power to the other egg-half.

Of the 30 perfect blastulas only 15 survived the second day—as is often the case with normally formed blastulas in small vessels. On the morning of the third day active gastrulas were observed, fifteen individuals. They then take on the prismatic form, mouth and arms are formed and the normal course is followed until finally, in 3 cases, normal, but small, plutei were raised.

If each half-egg may thus form a complete individual the possibility of forming twins by partial separation of the first two blastomeres is obvious. In fact very many cases of twin formation resulted from the experiments above recorded though in eggs not shaken none were observed amongst the many examined in other work. There is thus probability that the partial separation of blastomeres may give rise to twins. Of the numerous cases of twins actually observed one is especially noticeable as it shows that from a much injured two celled stage there resulted an apparently normal blastula which after two

days divided into two almost separated spheres each of which became a gastrula and finally a pluteus attached by a narrow isthmus to its fellow.

This abnormal action of the embryo is not confined to a simple two-fold division: in three cases the blastula divided into a ¾ and a ¼ section of which the former became plutei and the latter, in one case a gastrula. The general distribution of this power to produce complete individuals was more striking in a case where ¾ of a shaken egg, in the two celled stage, died and the remaining ¼ of the egg became a normal blastula!

Attempts made by the author to separate the blastomeres of Frogs and of Planorbis have as yet been unsuccessful. There seems need of extension of this experimental work before any wide-reaching conclusions can be drawn.

Regeneration of Lost Parts.[1]—In these two papers the author has given an important addition to our knowledge of the process of regeneration of the tail in Batrachia. Both adult and larval urodeles and larval anurans were used, though most of the work refers to Rana and to Siredon larvæ. In the first paper the interesting fact is established that tails cut off obliquely do not grow out straight at first, but at right angles to the cut surface, up or down, right or left as the case may be. Yet they become later like the original tails. This change the author assigns to the effect of use, to functional adaptation. This is made probable by a number of experiments in which larvæ were kept in deep and in shallow water, could or could not use the tail. Some of the final straightening in the non-swimmers is referred to the effect of gravitation, but there still remain cases in which only the "directive power" of the organism seems to be concerned in the ultimate return of the new tail to its proper use.

The great length of the second paper forbids its proper treatment in the present notice. Its chief advance over previous work, of which it furnishes a good confirmation, lies in the discovery of the fact that the histological changes concerned in the formation of the new tail repeat, on the whole, those of the ontogeny, not only in kind but in the time of appearance. Thus the epidermis is first regenerated, then the spinal cord, chorda, connective tissue, cutis, blood-vessels, striated muscles and peripheral nerves in the order given. Simple tissues are quickly regenerated, the more specialized, more slowly. Moreover,

[1] D. Barfurth. (1) Versuch zur functionellen Anpassung. (2) Zur Regeneration der gewebe Arch. f. mik. Anat. xxxvii, May, 1891.

the mode of formation of tissues like that in the embryo is dependent upon the ontogenetic stage of the individual, repeating only what is proper to the formation of such tissues at that stage.

Embryology of Rotifers.[1]—Passing over the anatomical and biological sections of the present long paper, interesting as are the new facts brought forward to support the author's belief in a symbiosis between certain rotifers and certain hepatic mosses, and the careful anatomical work upon the Callidinas studied, we will here give a brief outline of the embryological and theoretical sections.

The eggs of *Callidina rosseola* and *C. lutea* may be found by shaking out moistened roof-moss and examining the dust with a lens, or better, by placing a number of the ripe females in small glasses where the eggs are less liable to be rendered opaque by the adherence of foreign bodies to their sticky surface.

As the egg is large, elongated and requires 17 days to develop, it furnishes an unusually good chance to study the cleavage at leisure, there being moreover resting periods of long duration. From the author's account of the continued rearrangement and shifting of blastomeres within the egg membrane these eggs would seem also to be favorable objects for investigating the relationship of cleavage planes and cell arrangements to mechanical pressure and spacial necessities.

The polar body is exceedingly large (only in some cases were two present) and is formed on what proves to be the dorsal surface near the anterior pole, so from this early stage all the planes of the adult are oriented by this appearance at the end of one side of the elongated egg.

Of the first two cells the larger, I, takes the anterior pole, the smaller, A, posterior; both divide. The first progeny of I form a series of cells on the right side, the progeny of A are arranged on the dorsal and left side. Other cells are budded off from I and form a ventral series. Thus an elongated, solid mass of four rows of cells arise, having the large remnant of I at its anterior end, 16 cells in all.

An increase in the number of cells is accompanied by their moving forward over the remnant of I which now sinks into the interior and furnishes the cells of the entoderm: this being a solid gastrula stage. A few smaller, granular cells, likewise overgrown at the same end of the egg come to lie beneath the ectoderm and are regarded as furnishing the material for the pharynx and salivary gland.

[1] Carl Zelinka: Studien über Räderthiere Zeit. f. wis. Zool. liii, Nov. 1891.

Of the subsequent fate of the embryo to the time of its hatching in the adult form we can only note from the detailed organogeny given by the author the facts that the reproductive organs arise from two small sets of cells given off from the progeny of I, that is from the entoderm: that the nervous system and muscles both come direct from the ectoderm, the former as solid ingrowths, the latter as sinking in of separate cells, muscle cells. The excretory tubes arise from cells of undetermined origin. The flame cells are from the first blind tubes, closed by a protoplasmic mass bearing the numerous cilia.

The author also takes up, in less detail, the embryology of *Melicerta ringens*, a less favorable subject. Here also the precaution was taken to keep the observed embryos up to hatching to avoid the vitiation of results by study of abnormalities.

The cleavage is remarkably similar to that of Callidina. Yet the polar body is found towards the posterior, dorsal end.

Both male and female eggs have the same cleavage and subsequent development in spite of difference of size.

In the author's interpretation of the embryology of Rotifers there is no mesoderm, no middle layer. The sexual organs arise from the entoderm, the cœlon, muscles, pharynx and salivary gland from certain granular ectoderm cells, the circular muscles directly from the adjacent ectoderm and the excretory organs not from the entoderm but probably from the ectoderm. A comparison is thus drawn between the Rotifer and the Trochosphere—the great similarity being overbalanced by the absence of mesoblasts. Thus the Rotifer is to be regarded as an earlier stage than the Trochophore, wanting as yet the special mesoderm mass. The Rotifer is thus not a sexually mature Trochophere. Yet the possession of a subœsophageal ganglia points out a resemblance to the Molluscan trochophore, while there is also much resemblance to an ancestral form for the Polyzoa, Brachiopods and Chætognaths.

The "foot" of the Rotifer is not a ventral organ but to be regarded as a tail or posterior end of the body, having at first a terminal anus afterwards moved dorsally by the formation of a terminal adhesive gland. The embryology of this region is accepted by the author as homologous with that of the abdomen of Crustacea.

While the Rotifers thus stand as representatives of the ancestors of so many groups they themselves are to be divided, as the embryology indicates, from the "Protrochophora" of the Platyhelminthes.

Development of the Renal Organs of Amphibia.—In the Bulletin of the Museum of Comparative Zoology at Harvard College,[1] Mr. Herbert H. Field has published a paper on "the development of the pronephros and segmental duct of Amphibia. The early stage were rendered both in the Urodeles (Amblystoma) and Anurans (Rana, Bufo). The paper consists of one hundred and forty pages and is accompanied by eight plates. The descriptive part of the paper includes about the first fifty pages, giving a detailed account of the origin of the pronephros in the three forms.

After an extensive review of the literature the author concludes. "According to the account which at present receives most general acceptance, the pronephros first appears as an outfolding of the somatoplasm in the form of a longitudinal groove; the anterior end of this groove is destined to become the pronephros; the remaining portion is constricted off to form the segmental duct. Since the process of constriction advances from before backwards, stages may be found in which a completed tube is continuous posteriorly with a mere groove of the somatopleure. In the anterior region the groove remains in communication with the body cavity and grows down towards the ventral surface of the embryo in the form of a broad pocket. The slit-like peritoneal opening of this pouch closes throughout the greater part of its length leaving however two or three regions of incomplete closure the fundaments of the nephrotomes."

"In opposition to this view I would maintain; (1) that the first trace of the excretory system consists of a solid proliferation of somatopleure, the pronephric thickening; (2) that the lumen of the system arises secondarily; and (3) that the pronephric tubules do not appear in consequence of the local fusion of the walls of a widely open pouch, but that they are differentiated at an early stage from the hitherto indifferent pronephric thickening."

With respect to the development of the segmental duct the author writes: "As is well known, observers up to a very recent date have been almost unanimous in ascribing a mesodermal origin to this structure. In regards to the details of this process they have been less at one . . . . . According to one view the duct arises as an evagination of somatopleure, its lumen being therefore a detached portion of the body-cavity . . . . My own observations on Amphibia indicate that in this group the duct does not arise as a fold, and I am of the opinion that in both Cyclostomes and Ganoids the evidence that the duct arises as evagination is at present unsatisfactory . . . A second view of the

[1] Vol. xxi., No. 5, June, 1891.

origin of the duct is that it arises from a solid proliferation of somatopleure . . . In so far as these authors maintain that the duct arises from a solid profileration of mesoderm and acquires its lumen secondarily I entirely agree with them; but my own observations on this point lead me to conclude further that the duct arises throughout its entire length from a continous thickening of somatopleure and that the only free growth which occurs in the Amphibia studied by me is for the purpose of effecting a union with the cloaca.

"Finally it remains for me to consider the third view, that of the ectodermal origin of the duct, which is to-day advocated on so many sides . . . In my opinion the entire excretory system of the forms I have studied unquestionably develops without any participation of the ectoderm in its formation. The duct develops from mesoderm throughout its entire length and at its posterior end, in Rana and Bufo at least, comes in contact with one of the endodermal coruna of the midgut so that nowhere in its development does it come into organic union with the outer germ layer."

An intimate fusion in several processes between the duct and the ectoderm has been described but this fusion the author concludes is secondary and meaningless (?)

The remaining part of the paper deals with "those inferences of a general nature" drawn from a study of the pronephros.

"I conclude therefore that pronephros and mesonephros are parts of one ancestral organ; that the glomeruli are strictly homodynamous with the glomus; that the entire tubular portion of the pronephros is represented in the mesonephros; that the cavity of a Malphigan capsule and the nephrostomal canal connecting it with the body cavity are detached portions of the cœlom, the equivalents of which are not thus differentiated in the pronephros; that the pronephros is developed as a larval excretory organ; and that the period at which it appears largely accounts for its peculiarities of structure."

The closing sections are devoted to a consideration of the evidence which the development of the excretory system throws on the origin of the vertebrates. On the whole, the evidence brought forward does not add materially to the solution of the ancestry of the vertebrates and such a theory can only be established by investigations which shall include in their scope the entire organization of the two groups.

ARCHEOLOGY AND ETHNOLOGY.[1]

The International Congress of Anthropology and Prehistoric Archeology of Paris of 1889.—(*Continued from page* 1034, vol. xxv.)

Miscellaneous Contributions.

1. *Anthropological Studies in Japan.*—M. Shogoro Tsuboi, of the University of Tokio, made a report on this subject. He recalled the numerous works of strangers published upon Japanese anthropology and expressed regret that the writings of his compatriots were almost unknown outside of Japan. He mentioned the great osteological collection of the Medical College of the University, and its special laboratory. He enumerated the results obtained, statistics, photographs of ethnic types, simple or composite, studies in criminology, etc. Japanese ethnography and that of the Ainos particularly had been studied, and archaeological excavations had been followed with care from one to the other of the Empire, in the tumuli, shell-heaps, caverns, etc. The College of Sciences and the Museum of Tokio have been enriched with the result of these excavations, and there has been founded on the initiation of the author an Anthropological Society at Tokio. It has made its first exhibition in the Anthropological Section of the French Exposition.

2. *The Caverns of Central America.*—The prehistoric, or, at least, pre-Columbian monuments of Mexico and Central America have been studied and are tolerably well-known, and this much has been contributed to our knowledge of prehistoric man in that country. But it is not so with the caverns, for while they in many cases bear traces and contain evidences of human occupation in ancient times, they are for the most part unexplored.

M. Desire Pector, Consul of Nicaragua at Paris, himself an ardent prehistoric archaeologist, who was in charge of the Nicaraguan Building and display at the French Exposition, and was Secretary of the International Congress of Americanists, session of 1890, at Paris, presented a list of these, the most interesting of these caverns. He made elaborate and satisfactory descriptions, which must, however, all be omitted, and I must be content with a mere list.

a. Mexico.—The seven legendary caverns of Chicomoztoc.

[1] Edited by Thomas Wilson, Smithsonian Institution.

b. Guatemala.—The Cueva Encantada de Mixco. Described by Fuentes y Guzman in the year 1700. Its length was three leagues. It served the aborigines as a place of adoration and sacrifice in honor of the Divinity of the Fountain, Cateya, Mother of the Water or Goddess of the Water. The grottoes in the neighborhood of Mitla on Mictlan, of which the most celebrated were those of Tibulca and Penol.

c. Salvador.—Cavern near the village of Aguacayo and of the Rio Lempa. It is deep. The Cavern of Corinto. The Cueva y fuente de Sangre, near Amatillo, on the frontier of Honduras.

d. Nicaragua.—The Cavern of Metapa in the Dept. of Matagalpa.

e. Costa-Rica.—There are several caverns in the Province of Guanacaste or Liberia.

f. Venezuela.—One should not neglect the famous Caverns of the Orinoco; Cerro de Luno, Ipi Iboto and Cucurital, the antiquities of which with skulls of the aborigines, deformed and natural, have been recently found by Crevaux and Dr. Marcano.

The grand Cordilleras which cover Central America ought to contain many grottes on the flanks of the mountains. They have never been, or very slightly explored.

3. *The Cup Markings of Espiaux.*—Monsieur Julien Sacaze, of Saint Gaudens, who lately met with a premature death, communicated the Congress a note on the cup-markings of Espiaux near Bagneres-de-Luchon, Pyrenees. He gave a description. There were three series of these. The Calhande Pourics, the alignments of Peyrelade and of Couseillat. He gave a description of these stones, which while of granite boulders within reach of the glaciers of the Os and bearing marks of glacial action, yet had undoubtedly been placed in their present position by human intervention, and so were monuments of human art. Cavities of greater or less size and depth had been wrought in their surfaces, which were to be counted by the hundreds. These were cupstones, and were quite prehistoric, no person having within historic times had any knowledge of their origin or purpose. M. Sacaze believed these sculptures to be contemporaneous with the monuments which they ornament. The stones might have been sepulchral monuments and their ornamentation may have had reference to the cult of the dead.

This paper was exceedingly interesting to me, for I had visited this mountain of Espiaux, the alignments of Peyrelade, and had seen numbers of these cupstones. The cups were usually marked upon the face of the granite boulder.

M. Reber, of Geneva, gave as the latest archeological news from this country the discovery of five hundred cup markings on the rocks of Planet at Salvan in Valais. They were associated with other marks, ovals, triangles and rainures.

Cup markings had been found on the dolmen tombs of Douvaine in Savoy.

4. *Presentation of North American Indians Before the Congress.*—Dr. Topinard presented a band of twenty-five Indians who belonged to the troop of the Wild West under Buffalo Bill, then exhibiting in Paris. The Indians were mostly Ogallalla Sioux; one or two were Cheyennes. At the request of their commander they gave to the Congress a representation of the gesture speech which has been studied and described by Colonel Garrick Mallory. Mr. T. Wilson acted as interpreter, while Drs. Hamy, Laneau, Topinard, Mortilet and others asked questions and noted peculiarities in the Indianphysiognomy, their customs and equipments, while Mr. Kunz exhibited a collection of their ornaments.

When Will the Earth be Entirely Peopled?—In order to answer this question M. Ravenstein has undertaken a series of researches and calculations the results of which are published in the Proceedings of the London Geographical Society, 491, p. 27.

It appears from this work that the population of the globe, 1,467,000,000 of people, is distributed over the surface of the islands and continents, excluding the polar regions, in the proportion of thirty-one inhabitants to the English square mile (2.59 kilometres). The author divides the entire land surface, 46,350,000 square miles, into three regions; fertile lands, steppes, and deserts, which contain respectively, in round numbers, 28,000,000, 14,000,000, and 4,000,000 of square miles. He computes the maximum number of inhabitants which each of these regions can sustain per square mile as follows: fertile lands, 207; steppes, 10; and desert, 1. The average for India is 175, for China 295, for Japan 264. M. Ravenstein estimates the maximum of inhabitants that can be sustained on the entire land surface at 5,994,000,000.

At what date will this fatal number be reached? The increase of population in the different countries can be expressed, according to the author, by the following figures:

Europe	8.7	per	cent.	by	decade
Asia	6	"	"	"	"
Africa	10	"	"	"	"
Australia and Oceanica	30	"	"	"	"
North America	20	"	"	"	"
South America	15	"	"	"	"
Total	8	per	cent.	by	decade

With this ratio of increase as a basis, the figure 5,994,000,000 will be attained A. D. 2072, or in about 181 years.

It is a curious fact that this is very nearly the same date when, according to the geologists, the coal supply of Great Britain, which gives her prestige among nations, will be exhausted.

Our great-grandchildren will have reason to reflect upon the future and the fate of their posterity doomed to struggle for life under the hard conditions that may be summarized in these words: want of combustibles and room upon the face of the earth. (L'Anthropologie, Tome II, No. 6, p. 753.)

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Association of American Anatomists.—The fourth annual session was held September 23 to 25, 1891, at Washington, D. C. The officers for 1890–'91 were: Joseph Leidy, M. D., LL.D. (deceased), Philadelphia, Pa., President; Frank Baker, M. D., Washington, D. C., 1st Vice President and Acting President; Faneuil D. Weisse, M. D., New York City, 2d Vice President; D. S. Lamb, M. D., Washington, D. C., Secretary and Treasurer. EXECUTIVE COMMITTEE: Harrison Allen, M. D., Philadelphia, Pa.; Burt G. Wilder, M. D., Cornell University; Thomas Dwight, M. D., LL.D., Harvard University, President and Secretary, ex-officio; Mr. Fred. A. Lucas, of Washington, D. C., Delegate to the Congress; D. K. Shute, M. D., of Washington, D. C., Alternate.

Wednesday, September 23.—1. Opening of the session by the Acting President. 2. Report of Executive Committee. 3. Report of Secretary and Treasurer. 4. Election of new members. 5. Report of Committee on anatomical Nomenclature. 6. Proposed amendment to Constitution abolishing dues and substituting assessments. DR. ALLEN. 7. Proposed amendment to Constitution providing for Honorary Memberships, to apply more especially to foreign anatomists. DR. LAMB.

8. Miscellaneous business. 9. Resolutions and remarks upon the death of Dr. Leidy. Papers Read.—1. The fundamental principles of anatomical nomenclature. Dr. Burt G. Wilder, Cornell University. 2. The systematic use of the eye in teaching anatomy. Accompanied by a demonstration of a brain model. Dr. Wm. P. Carr, Washington, D. C. 3. Some impressions on the teaching of anatomy to medical students. Dr. Harrison Allen, Philadelphia, Pa. [Discussion opened by Dr. Dwight, followed by Dr. Baker.] 4. The fossa prænasalis. Dr. Thomas Dwight, Harvard University. 5. Notes on the hearts of certain animals. Ida Hyde, Chicago, Ill. [Read by Dr. S. V. Clevenger, Chicago, Ill.]

The members of the Association and their families were invited by the Acting President, Dr. Frank Baker, to visit, after the Wednesday morning session, the National Zoological Park.

Thursday, September 24.—Miscellaneous Business: Papers read. 6. Recent fissural diagrams. Dr. Burt G. Wilder, Cornell University. 7. The arrangement of the supracerebral veins in man, as bearing on Hill's theory of developmental rotation of the brain. Dr. Wm. Browning, Brooklyn, N. Y. 8. Morphological importance of the membranous or other thin portions of the parietes of the encephalic cavities. Dr. Burt G. Wilder, Cornell University. 9. The alleged lateral orifices, communications of the fourth ventrical with the subarachnoid space. Are they natural? Dr. Burt G. Wilder, Cornell University. [Being a reply to part of Dr. F. W. Langdon's paper, "Homology of cerebro-spinal arachnoid with the other serous membranes." Read at the Boston meeting in 1890. Published in Medical Record Aug. 15, 1891, p. 177.] 10. The structure of basis and cement substance. Dr. Charles Heitzmann, New York City. 11. Serial fœtal sections. Specimens and remarks. Dr. W. W. Gray, Washington, D. C. 12. The teeth of the Chiroptera. Dr. Harrison Allen, Philadelphia, Pa. 13. Specimens of supernumerary digits in man and the pig. Dr. F. J. Shepherd, Montreal. 14. The relative frequency of the psoas parvus muscle in the colored race. Dr. E. A. Balloch, Washington, D. C. 15. Certain modifications in plant morphology, produced by external conditions. Dr. W. P. Wilson, Philadelphia, Pa. 16. Comparative osteology of the North American Pygopodes. Dr. R. W. Shufeldt, Washington, D. C. 17. The supracondyloid process in man. Dr. D. S. Lamb, Washington, D. C. 18. Platycnemic tibias. Dr. Frank Baker, Washington, D. C. 19. History of anatomy as a science. Dr. G. W. West, Washington, D. C. 20. Congenital union of the quadrate jugal to the mandible in a

cockatoo. Specimens and remarks. Mr. Fred. A. Lucas, Washington, D. C. 21. Homologies of the principal bones. Mr. Fred. A. Lucas, Washington, D. C. Friday, September 22. 1. Election of officers for 1891–93. Election of Delegate and Alternate to the Congress. Election of one member of Executive Committee. 4. Miscellaneous business.

Natural Science Association, of Staten Island.—*January* 9th, 1892.—The following paper, illustrated by maps and specimens, was read by Mr. Arthur Hollick:

On the 4th of April, 1881, Dr. N. L. Britton read a paper before the New York Academy of Sciences on the geology of Richmond County. This paper was published in the Annals of the Academy, vol. ii, No. 6, and in it the prediction was made that Cretaceous clays would be found beneath the drift to the South and East of the Archæan Ridge wherever this covering of the drift might be removed. At that time Dr. Britton used the following words: "No fossil leaves or shells have been taken from the clay of Staten Island, but it is not improbable that they will be found at some future time, when the excavations are more advanced than at present. They are more likely to be found in buff or dark colored clays than in fire clay."

All subsequent geologists followed on the same lines, and on all geological maps of this vicinity the existence of Cretaceous strata on the south side of the Island is indicated. The actual knowledge upon which this assumption was based was, however, very fragmentary and unsatisfactory. The only known exposures of Cretaceous clay were at Kreischerville and in a ravine at Princes Bay, and how far these extended was not known. Nevertheless, every observant geologist knew what ought to be, and took it for granted that Dr. Britton's conclusions were correct.

Definite evidence in regard to the subject has been slowly accumulating, and especially during the past three months, important facts have come to light. Some of these facts were recorded by me at the time of discovery in our Proceedings. Others have never been placed on record. Following is a brief review of their sequence:

In June, 1883, a single cast of a large shell was found by Mr. W. T. Davis on the surface of a sandy field at Tottenville. It was identified by Prof. R. P. Whitfield, of the American Museum of Natural History, as *Pachycardium burlingtonense* Whitfield; but its significance was not realized by us, and it was regarded as most likely to be an accidental estray.

In November of the same year I picked up on the shore at Tottenville a few blocks or concretions of ferruginous sandstone, containing fragments of vegetable remains, evidently similar to specimens previously found at Keyport, N. J., and Glen Cove, Long Island. The identity of these was at once noted by Dr. Britton, and they were declared, almost with certainty, to be of Cretaceous age. (See Proceedings, Nov. 10 and Dec. 8, 1883.)

In November, 1885, fossil vegetable remains were found in one of the clay beds at Kreischerville. They were too fragmentary for determination, but were apparently identical with similar remains from the Amboy clays. (See Proceedings, Dec. 12, 1885, and Feb. 13, 1886.)

During the Autumn of 1888 a single fossil leaf was found by Mr. Gilman S. Stanton in a block of ferruginous sandstone at Arrochar, which fortunately came to my attention and was kindly turned over to me. As in the case of the *Pachycardium* found at Tottenville, however, its importance was not realized at the time, and the opinion was expressed by me that it was probably of Drift origin. (See Proceedings, Dec. 8, 1888.)

Outcrops of what was apparently Cretaceous clay and gravel were next discovered on the shore and in the ravine at Princes Bay, on the shore at Eltingville, and in a gravel pit on the North side of the Fingerboard road at Clifton. (See Proceedings, March 14, April 11, May 9, and Oct. 10, 1889.)

In the meantime the material from Tottenville was accumulating, some of the specimens being in far better condition than those at first discovered, so that they could be accurately studied and the species of plants determined, leaving no question as to their Cretaceous age. All the organic remains thus far found were vegetable; no animal remains having been even indicated, if we except the single *Pachycardium* previously mentioned.

On May 1, 1889, Dr. N. L. Britton and myself were exploring the clay beds along the Raritan River, at Perth Amboy, where we found ferruginous sandstones and concretions containing molluscs, but in all other respects identical with the leaf-bearing concretions from the shore at Tottenville. This encouraged us to believe that careful search on Staten Island would probably yield similar results, and such has been the case.

In October, 1891, I found molluscs in the concretions at Tottenville, and immediately afterwards at Arrochar. These and the ones from Perth Amboy were submitted to Prof. Whitfield and by him identified as Cretaceous species.

Finally, in November, 1891, I found well preserved fossil leaves of undoubted Cretaceous species on the shore at Princes Bay, in concretions in all respects similar to those from Amboy, Tottenville and Arrochar.

Following is a list of the molluscs, as far as they have been identified:

Corbula sp? (possibly a new species) Perth Amboy.
Terebratella vanuxemi Lyell and Forbes, Tottenville.
Pachycardium burlingtonense Whitfield, Tottenville.
Cardium (*Criocardium*) *dumosum* Conrad, Arrochar.
Ostrea plumosa Morton, (?) Arrochar.
Aphrodina tippana Conrad, or *Callista delawarensis* Gabb, Arrochar.
Gryphœa sp. ? Arrochar.

In addition to the above there are several species which are not in a sufficiently good state of preservation for determination. Of the vegetable remains the commonest species is *Liriodendron simplex*, Newb. *Protæoides daphnogenoides* Heer, *Eucalyptus genitzi* Heer, and other characteristic Cretaceous plants are represented, besides a number more, among which there may prove to be undescribed species. This material will be the subject of further study.

With the foregoing facts in our possession we are now in a position to feel reasonably sure that the prediction of the existence of Cretaceous strata beneath the Drift in the towns of Westfield and Southfield has been verified, but other points of interest yet remain to be discussed. The first of these is in regard to the character of the rock in which the organic remains are found. Its concretionary nature is apparent—the nucleus in all cases having been a mass of clay in which is enclosed the mollusc or leaf, as the case may be. Limonite often forms as a succession of layers over the outside and the clay is gradually transformed into a hard clay iron-stone. A large series of specimens collected show every stage in the process of formation, from soft clay to hard rock. In the softer material some of the carbon of the vegetation may yet be seen, but in the hard rock nothing except the impressions of leaf or stem remains. Finally, the question will naturally be asked, are these fossils in place where found? Some doubt was felt in regard to the specimens from Tottenville and Princes Bay, inasmuch as they were evidently washed out of the banks, the mass of which is composed of Drift material, in places enclosing considerable clay and yellow gravel. This is conspiciously the case at Princes Bay, as noted by Dr. N. L. Britton in the Proceedings of

November 8, 1884, and a deep talus, extending to the beach sands, has nearly always covered the base of these bluffs, so that the character of the material at the shore level could not be ascertained. Recent excavations at Arrochar have greatly helped in the solution of the problem, however, and I was fortunate in arriving there when a section was freshly exposed. This section showed at its base a bed of sandy micaceous clay, containing the characteristic ferruginous concretions, lying flat in the plane of the bedding. The next member was a bed of yellow sand and gravel, also containing concretions. The concretions containing the specimens of *Cardium dumosum* were dug by me out of these layers of clay and sand, and in the gravel I found silicified corals, so characteristic of the yellow gravel which overlies the Cretaceous clays in New Jersey. Above these beds, and conformable with them, there is about four feet of modified drift, the entire series dipping at an angle of about forty degrees towards the N. W. Bowlder drift covers the surface. That these beds have been subjected to considerable disturbance is evident from the position in which we now find them, and the stratigraphy of the subject would be an interesting matter for future investigations. It is highly probable that these isolated and limited exposures represent a large and probably continuous bed of Cretaceous strata underlying the entire region, as previously predicted.

Boston Society of Natural History.—November 18th.—The following papers were read: Dr. George Baur, A Visit to the Galapagos Islands; Prof. W. M. Davis, The Catskill Delta in the post-glacial Hudson Estuary.

December 2d.—The following papers were read: Prof. A. Hyatt, Relations of Ancient and Modern Pinnas; Dr. C. S. Minot, Recent Investigations on the Brain.

A general meeting was held in commemoration of late officers of the Society, Wednesday evening, December 16th, at 7.45 o'clock.—The following communications were made: Dr. J. C. White, Sketch of the Life of D. Humphreys Storer; Mr. Samuel Garman, Dr. Storer's Work on Fishes; Mr. S. H. Scudder, The Services of Edward Burgess to Natural Science; Dr. B. Joy Jeffries, Mr. Burgess' application of Science in naval Architecture, illustrated by stereopticon views of yachts and the international races; Profs. G. L. Goodale, C. S. Minot, and N. S. Shaler, In Memory of Samuel Dexter.

January 6th.—The following papers were read: Mr. Percival Lowell, Shinto Occultism from a Scientific Standpoint; Prof. E. S. Morse, On the Form of the Ancient Bow in Various Parts of the World.

January 20th.—The following papers were read: Dr. Charles V. Riley, Life History of Sphecius speciosus, Drury; Notes on Caprification; Mr. S. H. Scudder, The Tertiary Weevils of North America.

Biological Society of Washington.—November 28.—The following communications were read: Dr. George Marx, On the Structure and Construction of the Geometric Spider Web; Mr. Charles D. White, Some Peculiar Forms in an Upland Carboniferous Flora; Prof. F. H. Knowlton, Fruiting Ferns from the Laramie Group; Mr. Frederick V. Coville, Review of Kuntze's Revisio Generum Plantarum; Dr. C. W. Stiles, Notes on Parasites—*Spiroptera scutata.*

December 12th.—The following communications were read: Mr. Frederick V. Coville, Review of Kuntze's Revisio Generum Plantarum; Mr. E. M. Hasbrouck, Remarks on Dichromatism; Prof. Lester F. Ward, Recent Discoveries of Potomac Fossil Plants near Washington.

December 26th.—The following communications were read: Prof. E. H. Knowlton, A Fossil Bread Fruit Tree from the Sierras of California; Prof Lester F. Ward, Alphonse de Candolle on the Transmission of acquired Characters; Prof. B. T. Galloway, A New Pine Disease; Dr. C. Hart Merriam, Remarks on the Affinities of the North American Squirrels, Chipmunks, Spermophiles, Prairie Dogs and Marmots.

January 23d.—The following communications were read: Dr. C. W. Stiles, Notes on Parasites; *Myzonimus* gen. nov.; Mr. Theo. Holm, Studies of the Morphological Identity of the Stamens; Dr. Theobald Smith, On Peculiar Forms of Red Corpuscles in Mammalia in Anæmic Conditions.—FREDERIC A. LUCAS, *Secretary.*

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NATURAL ANALOGIES.

By S. V. CLEVENGER, M. D.

In several articles on biological subjects published during the last fifteen years, I have called attention to the importance of analogical reasoning in the consideration of many scientific subjects.

To a limited extent this process of reasoning is carried on by scientific writers generally, but more with reference to its convenience than with a full realization of its great importance; for example, the vibratory theory is made use of by physicists in discussing heat, light, electricity, and sound, and most authors on the correlation of forces, and modern philosophers like Herbert Spencer endeavored to reduce universal phenomena to simple terms such as the convertibility of matter and motion, but from first to last all these thinkers seem to have missed what appears to me to be the most valuable application of analogy to practical sciences.

It does not require much thought to concede that a house built of bricks will possess the properties inherent in individual bricks, such as uninflammability, degrees of porosity, impermeability to moisture and air, and even the colors of the original brick, but it has taken thousands of years to establish the fact that however highly differentiated the animal tissues may be they possess only attributes of the primitive cell, some having one or more abilities highly developed with others in abeyance.

Thus the protozoon eats, grows, reproduces; so does the man, and for the same reasons. Whether we regard the processes as homologous or analogous, these acts performed by every animal have their foundation in the ability of the primitive cell to do the same things. It requires a certain familiarity with zoology and physiology to be capable of appreciating this connection, and it is a hopeless undertaking to try to teach such conceptions to those who are not furnished with the necessary preliminary knowledge. And there are those who are instructed in such matters, who for the want of sufficient deductive ability are unable to see the dependence of the phenomena because to their untrained minds the complicated processes of ingestion, such as deglutition, insalivation, mastication, digestion, etc., apparently differ so radically from the simple assimilative act of the amœba.

The ends attained are identical, though the processes may differ, somewhat as the sun-dial, the hour-glass and the clepsydra differ from the modern watch. No matter how complex the organism, the individual cells that compose it absorb food directly, very much the same as do primitive single-celled animals.

The complicated differentiations, to those unfamiliar with the subject, differ radically from their origin, as Talmage imagines he differs from the ancestral ape.

That analogies have been considered useful in some ways is shown by many attempts to utilize them, as, for example, in the celebrated work of Bishop Butler, whose success in the application Huxley thinks was not very great, for the latter claimed that the story of Jack and the Bean-stalk could be proven by the same method of reasoning. The sloppy manner in which analogies have been selected to illustrate certain points show that while there was acknowledgment of their value there is universal ignorance of their real nature.

I firmly believe that there will eventually be elaborated a science of analogies which will bear a relationship to the imperfect usage of the past in such matters that the old bears to the present zoology and botany.

Spencer makes good use of the method in an essay on "The Social Organism," and pretty generally throughout his works, but I think that neither he nor any other author touches upon the special point which I shall endeavor to make clear in this article.

Superficial resemblances often betray writers into incorrect use of metaphor, figures, or simile, either of which is upon close inspection nothing but a rhetorical admission that analogy has its uses. But its abuses are all too numerous, particularly in attempts at allegory and the puerile fable.

Superstition arises from an imperfect observation of natural phenomena which science dispels by the growth of intelligence with more accuracy of observation; as alchemy and astrology were followed by chemistry and astronomy, so mythology, which is the savage attempt to explain the universe through crude conceptions, is gradually being superceded by philosophic recognition of the unity of the laws governing everything.

One of Lord Bacon's essays is devoted to an ingenious attempt at explaining ancient Greek and Roman mythologies as symbolizing profound wisdom, and no legend among them was too silly not to be reconciled on this basis. The confusingly complex ecclesiastical symbolization is the outgrowth of endeavors to find material equivalents for spiritual things, with such poor success that the Christian can see nothing holy in the crescent and horse-tail of the Mohammedan, while the latter derides the cross as "two sticks," and exclaims "Behold the Christian's God."

And now we come to the main consideration. It is nothing new that there are parallelisms between the acts of men and nations, but these connections were treated of as purely accidental, or at best as if they were caused by some inscrutable law. I am not aware that anyone has preceded me in announcing that so far from there being anything mysterious in such matters the interdependence of phenomena and the possibility of reducing all things, if not to their ultimates, at least to simpler terms, enables many of the operations of the universe to be better understood and simplifies them astonishingly.

But first of all to enable this insight, the scales of ignorance must be scraped from the eyes, for the past system of education that ignored the sciences would create this blindness. Sociological study depends upon a knowledge of biology in its widest sense, comprising such things as anthropology, ethnology, zoology, botany, comparative anatomy and comparative physiology, and the front door to all this knowledge is chemistry and physics.

It may not be possible for any one person to master all these branches in their entirety, and we daily encounter narrow specialists in scientific fields, who, for want of education, cannot see the bearing of all the departments of information upon their particular branch. Such are anatomists who know no botany or chemistry; botanists who know nothing outside of plants; chemists who can see nothing beyond their test tubes and reagents. But, other things being equal, no one is so well equipped to *begin* the study of the universe as is the one with a good training in chemistry.

During the great fire of Chicago it was observed that the marble fronts of the houses seemed to melt in the flames and that the bricks were the really fire-proof material, facts which did not surprise the mineralogist, who, with his chemical knowledge, knows that carbonate of lime readily calcines and that silicates resist heat.

Comparably the philosophical scientist can reason from cause to effect, or backward, intelligently, and see associations that do not exist for the one with purely classical knowledge. A house may be an aggregation of bricks, stone, or wood, and will behave toward fire, water, and air as its component materials enable it, without surprise to anyone, but when communities are made up of human beings the old-time historian never traces relationship in the behavior of one to that of the other. The whole had no relation to its parts.

Even among sociologists who recognize these dependencies, a deeper source of information was seldom sought, such as biology in general, and they might indulge in the general smile of contemptous ignorance if it were hinted that chemistry and physics could aid their research.

To illustrate that analogies have a deeper significance than is usually assigned them, let us take the instance of what has been called a "bread riot." People are starving; they are turbulent, rushing here and there, finally gathering at some warehouse where food is stored, which is soon scramblingly distributed and eaten. This proceeding on the part of the populace is instigated by analogous and in many respects identical conditions existing in each individual of the mob. The collection of cells composing each person are in revolt; they are badly nourished; the intestines, muscles, nerves and their cells are hungry; the blood corpuscles surge through the vessels irregularly and riotously. The white blood corpuscles particularly are more active than usual, exactly as the free amœba moves more rapidly when hungry than when fed. There is starvation excitement throughout the body. The lymph and vascular channels are ransacked for food, and what previously would have been rejected is now assimilated exactly as the starving rabble gather offal from the streets and alleys. The fat repositories are drawn upon with resulting emaciation; the cellular elements are enfeebled, and multitudes of them die, as occurs among the starving populace.

A single cell may become a source of irritation to the colony of cells by provoking action, and individuals seek to impress themselves upon a community by orating, sermonizing, lecturing, quarreling, fighting; all more or less ignorantly are seeking gain.

A modicum of such excitement may result in benefit to the colony of cells, as an individual's action may result in the common good. Great national activity may eventuate in benefit to the world. In all these cases the good done may be accidentally accomplished. An epidemic of insanity may become as wide-spread as during the crusades, as crazy physiological processes may be induced by a fever.

Metzchnikoff's description of phagocytosis, interestingly reviewed by J. L. Kellogg in THE AMERICAN NATURALIST, June, 1891, quotes Osler's summation as follows: "He says that Metzchnikoff has likened specific inflammation to a warfare in which the invading forces are represented by micro-

organisms, and those who offer resistance by leucocytes. The news of the arrival of the enemy is telegraphed to headquarters by the vaso-motor nerves, and the blood-vessels are used as an avenue of communication with the threatened region. When the invaders are established they live on the host and scatter injurious substances which they have formed. The active leucocytes make an attack and try to eat the micro-organisms, and some die in the fight. Their dead bodies form an accumulation of pus, and when many are slain the battle-ground is known as an abscess. The hostile force may be overcome resulting in the recovery of an animal, and if not, in its sickness or death. In our bodies, then, there is a standing army of moveable cells, which may be equally concentrated and attack any force which may appear."

Now let us see what chemistry will afford in further explanation. In plethora the cell is quiet. When sufficiently nourished it performs its functions calmly and deliberately; its basic substance, the living protoplasm, was defined by Hoppe-Seyler as consisting of anhydrous nitrogenous hydrocarbon molecules capable of motion in a hydrated medium; the dead protoplasm resulted from the hydration of these molecules; the assimilative, reproductive abilities of the cell depended upon this molecular life, while this compound molecule existed intact and was able to construct, develop and differentiate similar molecules out of the less complex by chemical affinity. The molecule lived and was part of the cell, which was part of the man, which was part of the mob.

In a condition of surfeit no one would deny that a molecule was comparatively idle, but during privation its tension is necessarily increased, and there is danger of its breaking down into its component elements or forming lower compounds.

Other sociological relationships may be traced, and in a loose way the human organism has been likened to a monarchy. In a series of articles entitled "Monistic Mental Science," published in the "Open Court," 1887, I took the ground that the ideal, highest man was a republic; that the association of cells throughout his body cohered and worked, or should do so, in health, for the common good of the organism; that the ner-

vous system, including the brain, related the parts intelligently to conserve life purposes. The nervous system governs the body, but it receives its power to do so from the aggregated cells, and in this sense is a republic, and proper consideration of analogies will eventually work out clear conceptions of the social organism. It is the common idea that kings, parliaments, presidents, legislatures, congress, constitute the brains of society, when in reality they are one and all intestinal ganglia.

The Chinese locate intelligence in the abdomen, and the European, without being aware of it, mistakes abdominal for intellectual processes, and here is an instance where a better appreciation of things in general can be arrived at analogically. The real brains of a community consist of (it would seem trite to say) those who think, particularly those who think for the common weal; the philosopher, the scientist, the investigator stand in the front rank as brains; even the inventing mechanic should have high rank, and all such thinkers, in spite of the fact that they are not so recognized popularly. Heretofore, and to a great extent to-day, the real brains of a community are neglected, starved. In times of dearth they are the first to suffer, just as the reasoning power abates in sickness, and emotionalism develops.

In this and other respects a clarifying of our conceptions must occur before natural analogies shall be recognized as capable of being erected into a science. At present in this respect we are in a blundering, forming stage. Superficial resemblances for the most part have been used in analogy, and its profundity and capacity for exactitude have not been seen. One consideration alone baffled the carrying out of analogies, and that is, that in comparing an organism to a nation, it was considered necessary to make use only of living material, when in reality living material coheres with the inorganic, or what is called the "formed or dead material" of Beale. In the functions of the body there is use for such parts as the bones, just as machinery of all kinds, the telegraph, etc., are essential parts of a social organism.

The cells of the body are used up, die, or are cast off, but the man lives on. The individuals of a city perish here and there and are buried, until in a few generations there is an entirely new population, but the city, more or less changed, still exists. The molecular interchange of the cells is identical with this, and while so far as time and general processes are concerned there are differences, the operations of the nation depend upon the organism function, this upon the cellular, and the cellular upon the molecular. Nor are the activities so radically changed as we might imagine. The whole end and aim, physically speaking, is the conversion of molecular into mass motion, death reversing the process. The molecular life may be less than a minute; the cell life duration cover a few days or longer time; man may live nearly a century; the nation ten times as long or longer, but disintegration in some form or other overtakes them all, and history has to be studied in a new light to determine when the death took place.

The hermit crab is not the builder of the shell he lives in. Egypt will some day be wholly occupied by Europeans, and so in regarding the life of a city we may mistake the persistence of a shell and overlook the fact that the social organism which constituted the real city may have long since passed away.

Sociologically, merchants, bankers, etc., are the nation's intestinal or other visceral cells, and that they do not eat up everything that passes into their custody is solely due to their not being able to do so.

Common carriers may be the blood-vessels.

Telegraphs and other such means of communication constitute the nervous system.

Laborers, soldiers, are the muscle cells.

So-called rulers and law-makers (whether in republic or monarchy), merely obtain their power from the general units, and serve to correlate the intestinal and vascular operations as the sympathetic system does.

The professors, authors, and other real thinkers generally afford the unrecognized brains of communities, however starved and neglected; and, as individuals are usually guided emo-

tionally and think afterward, so the real brains of a community are disregarded in the main.

Pathological conditions infest communities as well as individuals, from want of harmonious working of parts. When the elaborating, transferring apparatus of a person or nation, as the intestines and blood vessels, or merchants and railways, either separately or together, become too selfish, and want to absorb everything, it is an easy matter to induce the intestinal ganglia legislature to adjust means for so doing; but, as this means death to the organism in general, a feverish condition may follow that threatens the national life until an equilibrium is restored. The intestines are often traitors to the commonwealth, but so may be other associated parts.

The workings of the nervous system, especially that of the spinal cord with its gray centre and white columns, may be explained some day by an application of electrical laws, particularly when the latter shall be better understood. New principles are yearly being worked out in this realm. Carefully applied reasoning may enable *an explanation of physiological mysteries* that cannot be possibly arrived at any other way. Many of the viscera are not so well understood as they should be. The functions of the spleen, liver, and pancreas, while much better known than formerly, are still to a large extent "sub judice." Analogies may enable us to better understand these parts, and in turn a better understanding may be reflected upon sociological and other matters.

In the American Journal of Psychology, Jan. 1890, the following comment occurs on the discussion between Weismann and Gotte (*über die Dauer des Lebens, und der Ursprung des Todes.*) "We may illustrate Gotte's idea by an analogy. Essentially there is no difference in the idea of death as applied to biology and as applied to the death of a literary society when the members agree to disband, possibly to found new societies. If we could feel sure that the analogy is sometimes more than a mere analogy, but at bottom is a universal principle of life, we could gain immensely by the mutual comparison between sociology and biology. There are many terms and ideas common to the two sciences, such as division

of labor, development, atavism, colony, etc. Reproduction by self-division might be illustrated by a splitting of the tribe into two. Budding, by the founding of a colony by emigration of individuals representing different trades needed in the new colony. Sexual reproduction, by emigration of a single couple, and the gradual development (embryology) of the colony with differentiation of labor as the individuals increase in number. The individual in this illustration represents the gemmule. The integrity of a state does not depend upon the number of persons, though the amount of its activity and wealth does. Similarly in the cell, the gemmules may be of like nature, and vary much in number. Here the illustration favors the view of Kolliker rather than Weismann.

"Although the work of two persons may be different, they are essentially alike in characteristics, and the descendants of any person in a state could found a similar state if forced to do so by emigration."

The same journal in the connection of criminology, suggests that "the whole study of pathological humanity may do for humanity what pathology has done for medicine."

Analogy (which is often identity) may be used to illustrate psychological processes. For example, the individual thinks pretty much as the social organism does. Seldom is a community wholly guided by superior thought. Its mercantile, transportation, and intercommunicating machinery is hard at work on the victual and clothes question. Amusement comes next. If a subject such as popular reform, inebriety, education, comes up, any person with advanced views will be talked at and about, by silly vaporers, and his ideas will be contested; this or apathy may smother the measure, the organism goes blundering on, guided by average expediency.

Methods of rural village, town, and city workings are comparable to those of individuals with different degrees of wealth and intelligence. As in higher animal life there is better co-ordination and correlation of parts, so in the growth of a community there is a tendency to increased subordination to intelligence, for the higher grade intellects may eventually impress their ideas upon the commonwealth.

Sulphur, carbonate of lime, silicates, chloride of sodium, and other inorganic substances enter combined or uncombined into the composition of carapaces, shells, bones, serum of living animals, pretty much as telegraphs are integral parts of the social organism. Several years ago in a work entitled "Comparative Physiology and Psychology," I argued that primarily, some of our ancestral animals accidently picked up a nervous system, consisting of phosphatic granules, which became linearly arranged by action in the line of least resistance, forming axis cylinders which became encapsulated, precisely as do many foreign substances in the body.

Professor Cope advanced the doctrine of "Acceleration," by which is meant that every time an ontogenesis is reviewed, the characters appear at earlier and earlier periods, or in other words, the developmental history is compressed to give room for the later added requirements. Adapting this to national matters, the United States seems to be rapidly passing through stages which required ages, comparatively, in older nations.

Written languages tend to become phonetic in spelling; more rapidly in America where conservatism is not so strong as in England, less rapidly in France owing to euphony being paramount; in Spain, Portugal, and Italy, it has been accomplished for many decades, radically in the last named country; in Germany there would seem to be little to be accomplished in this direction, but in the last twenty years the silent letter "h" may be omitted. Conservatism holds on to unpronounced, absolutely useless letters under various pleas and biases. How very like this is to the unfaithful copying of ontogenesis by phylogenesis. The abridgment occurs in the interest of the individual and the race, with here and there fossilizing tendencies against alteration.

The rapidity with which phonetic spelling advances in America indicates that Cope's law of acceleration is at work to develop the United States in this as in other regards beyond the capabilities of its senile parentage. Many other useful innovations are similarly made and meet with resistance. And yet without conservatism there would be no advance, for,

in general, resistance to the new until its utility is demonstrated, prevents the adoption of many vagaries.

In past generations, boys up to fourteen and sixteen years of age were greatly influenced by dime novel, Indian and pirate tales. No matter what the cause may be (probably the dissemination of better reading matter), it is the boy of ten years, or younger, nowadays, who affects such reading, and this may be likened to a condition existing in the days of knight errantry, when cock and bull stories of fights with dragons and giants were rife among every class of adults. Bombastic and emotional influences for centuries back existed generally among all, and more recently the Capt. Marryat style of novel lured young men to become sailors, and in some instances, pirates.

As the individual repeats in his life-time the history of the world, so to speak, he must pass through the stages of puerile belligerency, until he profits by his own experience, or that of others, and a boy of to-day, by the law of acceleration, passes more rapidly through these periods than did the one of a generation ago; and going back we find a period when a lifetime was required to outgrow this disposition.

Friends fall away during misfortune and are attracted to wealth and power, in obedience to laws which are identical with those that create parasites among plants and animals and the so-called messmates of the latter: the attraction of single and multiple celled organisms to food; and all these find their fundamental causes in laws of chemical attraction and repulsion of atoms.

Increase in chemical and mechanical motions often induce atomic interchange and molecular motion and recombination; as for instance, stirring a compound to produce precipitation or crystallization, changing the temperature of re-agents to produce a reaction, heating a battery to increase electrical generation, and so massage or bodily irritation draws blood to a part and stimulates physiological processes.

The stirring up of individuals by excitement increases the working capacity, and communities are similarly affected by causal relationship in these matters. If a nation is impelled

to greater activity through mental influences, it is because the molecular makeup of many of the individuals composing the nation is in a state of changed activity.

Without the atoms there would be no cells; without the cells no man; without the man, no nation; and activities among either affect all of them. For many years as a student of diseased mental processes, I have often satisfactorily combated such things as delusions of persecution, morbid fears, apprehensions, and fright, particularly in incipient insanity, by an application of the following reasoning:

In a healthy state, a fright produces certain sensory and motor phenomena in the body, such as rapidity of heart action, capillary dilatation and contraction, temporary muscular paralysis, and in extreme cases, perspiration and loss of sphincter control. Now as these are the usual expressions of fright, it is plain as anything can be that if disease may so interfere with the nerve mechanism as to produce any or all of these associated effects, it would be natural for the mind to interpret them as being due to the usual cause. For example, fear may make the heart beat fast. I have known an organic disease that interfered with the pneumogastric branches at the base of the brain, or with the cardiac sympathetic nerves running from in front of the spinal column to set up irregular heart action, and a feeling of dread or apprehension, or even terror will be thus caused by association, unless some compensating influence, which is not usual, interferes.

By artificial regulation of the heart's action, both the physical and mental disturbances may be caused to cease. Evidently a fright stimulates the heart muscle to greater activity, necessarily causing greater commotion among its cellular molecules, and the reverse condition is also true. The molecular action of the heart muscle may produce fright.

I would divide analogies into two particular classes, the apparent, and the real. The fact that as we advance in knowledge, resemblances in the mode of operation of widely unlike phenomena are being more clearly seen, and that even by the lowest races, resemblances are more or less accurately traced, justify the prediction that some of our greatest revela-

tions of the universal workings will be obtained through a scientific study of analogies.

The apparent analogy may be taken as tentative, or it may be wholly false, or merely poetical, such as is afforded us by the allegories and mythologies, and even scientific writers may find a use for an apparent analogy in illustrating certain matters.

The real analogy is such by direct interdependence and relationship, and the great difficulty in determining its reality lies in the necessity for the accurate understanding of these relationships.

It is not possible for any one human mind to be thoroughly versed in chemistry, physics, biology, psychology, geology, and astronomy, and for this reason the one who may be familiar with one or two branches and have a fair knowledge of the rest, will be able only to generalize, but his suggestions could be heard and amended by a worker in complementary fields, and eventually a synthetic study can be erected, unifying what is known in these various departments, and thus astronomy may come to explain a problem in microscopy; biology may clear up a chemical point; and sociology, in the light of the other sciences, may explain an otherwise inscrutable physiological matter.

Necessarily the history of the past may thus be laid bare, and ethology may become a science such as David Hume little dreamed of. The reasons for behavior, the feelings, passions, vices, and virtues, may thus be seen. It will be found that we are truly creatures of circumstance.

The significance of institutions may be more easily understood in their relation to the commonwealth. We may be better able to determine whether a measure will be useful or harmful, for example, when we make comparisons of certain physiological processes with sociological ones, there may arise a necessity for assigning a certain contemplated national movement to its proper place in the general economy. These comparisons may enable us to prove that instead of being a newly evolved useful structure, it may be in the nature of a cancer or an ulcer hostile to the national life.

Plato's model republic was founded upon vague correspondences between mental and social divisions. Under Reason, Will, and Passion, he placed counsellors, the military and the people, and Hobbes pictured the State as a monster "Leviathan." Herbert Spencer deserves full credit for formulating many analogies in the light of biology, and in the essay on "Social Organism" lays down parallelisms and leading differences well worth studying. Some of which are as follows:

The differentiation of labor is universal in all kinds of development.

Among primitive people the ruling class is comparable to the ectoderm, the governed to the entoderm, and when with later evolution the trading class was created, then the mesoderm arose, which furnished the distributing avenues. This may be taken to represent Europe in the feudal period.

Great activities in society may abstract capital in one direction at the expense of another, just as over cerebral excitememt may draw blood from the abdomen and cause indigestion. In the lowest animals there exists no blood. Among aborigines there is no circulating medium.

Circulating methods and channels increase in complexity in the ascending scales of animal and national evolution.

The growth of a consolidated kingdom out of petty baronies is like an advance among the species of Articulata. Closer commercial and governmental unions between the several segments subordinated to a cephalic ganglion.

England of to-day, Spencer would compare to some much lower vertebrate form than the human.

Parliaments discharge functions that are comparable to those discharged by the cerebral masses in a vertebrate, he says in the essay, but he refused a seat in parliament, as he denied that it was any place for a high order of thought, stating that that body did not govern or make laws, but merely promulgated what was indicated to it by extrinsic (mainly popular) influences. And in this idea of the legislative and executive being the cerebral and cerebellar parts lies a great field for discussion.

My view is that scarcely any nation has much more than passed the invertebrate stage. At least all are pretty low in the Simian scale, if as far advanced as that. Some may be likened to ferocious gorillas, brutal baboons, capering lemurs. The highest are scarcely as thoughtful as the chimpanzee.

But seriously, the Science of Analogies, merits very deep consideration as promising revelations obtainable in no other way in chemistry, physiology, biology, sociology, in all their ramifications. The orbits of the planets have been with reason found analogous to molecular rotations and between the atom and the star lie universal principles applicable to a better understanding of mental and physical laws of animals and society. History will by its means be read in a new and brilliant light, and the ideal nation may possibly be evolved from the better understanding of what would constitute one.

THE TWO SCHOOLS OF PLANT PHYSIOLOGY AS AT PRESENT EXISTING IN GERMANY AND ENGLAND.[1]

By E. L. Gregory.

It is an admitted fact that the science of vegetable physiology has reached a stage of development in the different scientific schools of Europe in advance even of the same department of animal life. It is also well-known that in Germany the three most prominent men who have contributed to this result are Naegeli, Sachs and Schwendener.

The expression "Two Schools of Plant Physiology" is one, however, which requires some explanation, and possibly, defense. It implies that the various conflicting theories which are at present occupying the botanical world may be traced back to two distinct sources, which, if true, is a fact not so universally known or admitted.

All scientific students whose knowledge of botany extends as far as a mere superficial acquaintance with the ordinary text books, are more or less familiar with the position occupied by Sachs. His text book may be said to be the first general text book on the science of the plant kingdom; that is, the first reckoning from that time when our knowledge of the phenomena occurring in this kingdom and of the laws governing them was considered sufficient to warrant the expression "Science of the vegetable kingdom." The various text books of general botany written before this time are now considered of little worth except as historical records. It is partly owing to this fact of priority that all our later text books bear so strongly the impress of Sachs' personal teaching. His name is constantly repeated in connection with the principles which he advocates, whether these principles owe their discovery to him or his predecessors. It is, therefore, impossible to read any of the ordinary text books without becoming somewhat familiar with the ideas and theories advocated by Sachs.

[1]Read before the meeting of the American Society of Naturalists, Phila., Dec. 29, 1891.

It is, however, quite different in the case of the works of the two others, Naegeli and Schwendener; especially is this true of the first named, whose long and busy life presents a record of intellectual labor and achievement possibly unequaled and probably unsurpassed by any other scientist of the present generation. He was a teacher, like the other two, and not only retained his position as professor of botany in the University of Munich, but fulfilled all its duties up to the day preceding his death. Unlike the other two, he seemed to lack in some degree that quality of mind usually so predominant in teachers, namely, the necessity of impressing its mode of thought on other minds. He was a sharp, keen, and logical thinker, and directed his strongest efforts in search of unknown truths. Although he may not in any sense be considered the founder of a school, it would be impossible to discuss fairly the present condition of this science without referring to the influence of his thought and labor.

The object, therefore, of the following paper is to consider briefly the present condition of plant physiology as it now stands in Germany and England, represented as under the controlling influence of two men, Sachs and Schwendener. A paper claiming such an object must necessarily contain much that is personal in character; it may, therefore, be allowed the writer to disclaim, at the outset, all design of personal defense or attack, whatever the appearance may be, the purpose being to show, as clearly as possible in such brief limits, the principal features presented by the teachings of two men whose methods and theories are in some respects antagonistic.

Again, in farther explanation of this purpose, as before intimated, the teachings of Sachs have become familiar through the works and text books of his numerous students and disciples. It is, perhaps, quite safe to say there is not a single text book on plant physiology which in all its important features is not based on the principles expressed and advocated by Sachs.

On the other hand, it is equally true that if there is a school of scientists opposed to many of these theories it has not yet reached the position to lay claim to this title by the publica-

tion of text books. In short, this school is of a date so recent that comparatively few of its theories are accessible to the English-speaking world. As an illustration of this fact, one of the most strongly contested points of disagreement between Sachs and Schwendener is in reference to the cause of twining stems. Vines in his text book of physiology gives the theory of Sachs and also those of various later writers, and among others refers briefly to that of Schwendener in these words: "Schwendener attributes the twining to circumnutation and to an antidromous torsion." Professor Schwendener said of this after reading it carefully, "This is quite erroneous; he has entirely misunderstood my theory. According to my explanation of this fact, torsion is only an effect of twining and not a cause."

In that department of plant physiology which deals with nutrition there are fewer differences of opinion than in that of the physiology of movement. It is in the latter field especially that Professor Schwendener has worked out solutions of various problems differing vitally from those of any other physiologists. In fact, his fondness for mechanical questions has given him the reputation of a specialist in the narrow sense of the term. Added to this is the fact that his discussions of several theories are so abstruse as to render them difficult even for the mature students who are likely to choose such studies in the German Universities. Thus, in speaking of his work on the position of leaves, he said it was extremely difficult for his advanced students who had been under his own training to follow his lectures on this subject; that with all his illustrations and models which he had constructed for these lectures it was often necessary for him to go twice through the same lecture, and that he never felt certain of the number who had conquered the subject until he had tested them in the laboratory.

Again referring to Vines, who may be considered at once the best exponent of the views of the English botanists and a fair disciple of Sachs, he says of this: "Schwendener has constructed an extremely simple theory regarding the position of leaves."

This implication of narrowness and specialization is, in the writer's opinion, extremely unjust and lacking foundation in truth. The fact that he chooses to devote special attention to the mechanical problems connected with the subject of growth by no means proves his unwillingness or inability to cope with all the questions connected with the subject, those referring to plant nutrition as well as those of growth. It is, however, unquestionably true that the habit of reasoning induced by studies of this nature is such as to lead to a different treatment of the questions of plant nutrition from that adopted by most of his cotemporaries.

For example, in all those questions included in the general term, "plant-metabolism," his views may be said to be strongly conservative when contrasted with those of the school of Sachs. Among the latter are many who express the hope of being able to trace the course of the changes connected with these processes in such a manner as to prove by actual weight and measurement the principle of conservation of energy. There are no text-books on plant physiology except, perhaps, a few elementary ones, in which the author does not run through some mode of reasoning either attempting to prove it, or show how it may possibly be proven. Starting with the process of CO_2 assimilation as it is called, an arbitrary equation is formed which may, or may not, show the changes undergone in this single process. The equation is purely arbitrary, no proof whatever can be given of its truth, except that it expresses how the relations might be adjusted. A much more difficult matter is undertaken by those who try to explain the process occurring in the changes caused by respiration. All the German text books, Sachs, Pfeffer, Weisner, Reinke, Detmer and others, all have tried to give some hypothesis which may explain the exact nature of the changes by which the rhythm of destructive and constructive metabolism is kept up in the living processes of the plant. The physicist and the chemist both are able to carry on their computations, weigh and measure to the smallest fraction and verify their theories by actual demonstration. So far the botanist has tried in vain to apply the weights and measures of Physics

and Chemistry to the results of action connected with the living portions of the plant. The difficulty lies not only in the extreme delicacy of the material in question but in the danger of interference with the processes as they go on.

Schwendener and his followers claim that we have not yet reached that point in the development of the science where such questions may be asked with a reasonable hope of a satisfactory reply. Our knowledge is too meagre and our means of acquiring more are as yet inadequate. In other words, they claim that the methods now used are incorrect, inasmuch as they do not aim at constructing a theory which shall satisfactorily account for certain facts, but they presuppose the existence of the facts, and the methods result, for the most part, in mere conjectures and speculations which count for nothing.

Whether this view be true or false it is unquestionably the source of the implication of narrowness and onesidedness before referred to, as obtaining against Schwendener among his own cotemporaries and his own country. Even here, however, it cannot be said that there is any actual difference in opinion between the two schools, only that the methods and results so far obtained by the one, are held in very light esteem by the other. It is very different when we come to the various problems connected with the growth and motion of plants. It is in this field particularly that the difference of opinion between the two men leads to positive difference in the teaching and modes of treatment of several important questions.

Schwendener gives, each year, a course of advanced lectures covering the following ten subjects.

1st. The mechanical principle in the development structure.
2nd. Theory of leaf position.
3rd. Mechanics of stomata.
4th. Bending of the medullary rays in eccentric secondary growth in thickness.
5th. Torsion, as caused by hygroscopical changes.
6th. Ascent of sap; hydro-mechanics of.
7th. Mechanics of twining.

8th. Nyctitropic movement of leaves.
9th. Mechanics of irritation movements.
10th. Flying apparatus of fruits and seeds.

All of these ten subjects he treats from his own standpoint, giving the results of his own experiments and study, except, perhaps, the last one, which is sometimes omitted for lack of time, and it is one to which he has given less attention than to the remaining nine.

From these ten subjects there may be selected three in which his opinions are diametrically opposed to those of Sachs and his followers; several of the rest are not treated at all in the latter school; and to the three here mentioned may be added two more important questions in which Schwendener differs radically from other physiologists. He gives the following list as including the most important questions of difference between his opinions and those of Sachs.

1. The problem of the ascent of water.
2. Cause of the year's ring.
3. Bending aside of the medullary rays by the rind pressure.
4. Mechanism of twining stems.
5. Turgor, its influence on growth of cell wall.

These may be said to represent fairly the important points which serve to separate the new school from the old. It is hoped a brief consideration of some portions will be sufficient to vindicate the right of the new school to this title, claimed for it here for the first time.

The problem of the water ascent is one in which Schwendener not only differs from Sachs but also from a large number of other botanists, who cannot be considered the followers of Sachs. The theory held by the latter and his school is, that the water rising in stems more than 30 feet high is for the most part carried through the lignified cell-walls. Schwendener and a large number of other botanists believe it is carried through the lumina of the cells. The difference, however, in the theory as taught by Schwendener and these other botanists, some of whom are, in other respects, his followers and adherents, is that they claim to give an exact explanation of the

manner in which this is done. On the other hand, Schwendener, who treats this question at length, denies our ability at the present condition of botanical knowledge to explain how the water is driven up. The agent he gives, but of the manner in which this agent works, he says we know nothing.

His treatment rests on a long series of experiments, the last of which were made several years ago and conducted as follows: A forester several miles out of Berlin was authorized by the government to allow the forest under his charge to be invaded for scientific purposes, and a small lodge was built where one of Schwendener's assistants remained for several weeks, in fact about eight weeks, so that the experiments might have an uninterrupted course, the professor going over every few days to perform the manipulations himself, while the assistant remained to watch and report the results.

(To be continued)

THE ZOOLOGY OF THE SNAKE PLAINS OF IDAHO.

By C. Hart Merriam.

The basin of the Snake River in Idaho is an undulating, sage-covered plain, stretching completely across the State in its widest part. It is crescentic in shape (with the convexity to the south) and measures about 600 kilometers (375 miles) in length by 120 to 160 kilometers (75 to 100 miles) in average breadth. Its boundaries on the north and east are everywhere sharply defined, consisting of rugged mountains rising more or less precipitously from the plain. In several places these mountains project southward in parallel ranges, like so many fingers, alternating with northward extensions of the plains, which occupy the valleys between them. Such valleys are those of Birch Creek and Lemhi River, Little Lost River, and Malade or Big Wood River. On the south and west the Snake Plains are not so well defined, passing south ward into Utah and Nevada between irregular ranges of mountains, and westward and northwestward into Oregon and Washington, where they are continuous with the Malheur Plains and plains of the Columbia. The altitude of the basin along the course of Snake River is about 1,800 meters (nearly 6,000 feet) at the eastern end, and less than 900 meters (3,000 feet) at the western, and its sides rise on the north and south to the altitude of 2,000 or even 2,150 meters (approximately 6,500 to 7,000 feet), forming a broad trough whose general direction is east and west.

The dominant feature of the Snake River basin is sage plains—rolling, uninterrupted plains, rising so gradually from the bottom of the basin as to appear almost level, and stretching away in every direction as far as the eye can reach. The plains are everywhere arid. The few streams that reach Snake River by a surface course usually flow in lower channels and do not water the region on either side.

The surface rock which crops out here and there over the sage plains proper is dark basaltic lava. It appears in the form of irregular masses or beds, extensive lava flows, and in

a few instances of broken down craters, the largest of which, Big Butte, rises about 600 meters (2,000 feet) above the plain. Some of cañons of Big Butte support a growth of Douglas fir and Murray pine. The lava flows present great diversity of form; elevated ridges of rough rock irregularly fissured and with jagged edges alternate with smooth, flat domes, suggesting giant bubbles; nearly level stretches marked by wavelets and ripples which bend and double, spread out as if just escaped from a seething, tumultuous caldron, while in many places the thick crust has fallen in, leaving deep pits of circular or elliptical outline, exposing the mouths of dark caverns that extend to unknown depths and furnish homes to owls and bats and a multitude of nocturnal animals. This black lava or basalt overlies an earlier flow of porphyritic trachite, gray in color and much less firm in texture. The Great Shoshone Fall, commonly known as the "Niagara of the West," results from the cutting down of the river bed through the hard basalt to the softer trachite below.

In summer the heat is excessive, the thermometer frequently reaching 110° in the shade, while in winter the snow covers the ground, and icy winds sweep over the plain. The forms of life which inhabit the region, therefore are such as can endure great heat during the season of reproductive activity, and can avoid the cold of winter by migration or hibernation; or if they remain active throughout the year they are hardy species, able to withstand great extremes of temperature and humidity.

Most of the rivers which flow down through the mountain valleys disappear on reaching the plains, and the greater part of the water which reaches Snake River does so by subterranean channels. Hundreds of springs pour their waters into the lava cañons of Snake River, usually at or near the bottom, and many of them are of great size. In winter their temperature is considerably higher than that of the river. Crayfish, identified by Mr. Walter Faxon as *Astacus gambellii* Girard, abound in these warm springs and are much sought after by raccoons (*Procyon lotor?*) and a small shell, identified by Dr.

R. E. C. Stearns as *Fluminicola nuttalliana* Lea, is exceedingly abundant on stones in the same springs.

It is a common feature of the Snake Plains, as of many other arid parts of the West, that the rivers which do not sink cut for themselves deep channels with precipitous walls, their present beds being several hundred feet below the general surface level. Of this character are the grand lava cañons of Snake River itself and many of its tributaries, particularly on the south side. As a rule these cañons cannot be seen until their very brinks are reached, and it is not often that they can be crossed on horse-back.

The northern boundary of the Snake Plains is formed by the lofty mountains of central Idaho, and by that part of the main range of the Rocky Mountains which bends directly westward from the Yellowstone National Park. Three narrow parallel valleys penetrate the mountains of east-central Idaho in a northwesterly direction, carrying slender tongues of the sage plains all the way to Salmon River.

The soil of the Snake Plains, where not lava or sand, is generally alkaline, and the characteristic plants, in addition to the ever present sage (*Artemisia tridentata*), are such Sonoran species as *Atriplex confertifolia*, *Atriplex nuttallii*, *Artemisia pedatifida*, *Sarcobatus vermiculatus*, *Tetradymia canescens*, *Eurotia lanata*, *Eriogonum cernuum tenue*, several species of *Bigelovia*, a *Malvastrum*, and two or three kinds of cactus. *Artemisia trifida* and *Purshia tridentata* are common in the higher levels; and *Iva axillaris*, a saline species, was found at the sinks of Big Lost River.

The characteristic birds of the sage plains are sage sparrow (*Amphispiza belli nevadensis*), Brewer's sparrow (*Spizella brewerii*), sage thrasher (*Oroscoptes montanus*), burrowing owl (*Speotyto cunicularia hypogœa*), sage hen (*Centrocercus urophasianus*), and sharp-tailed grouse (*Pediocætes phasianellus columbianus*), though the latter is rare in the area traversed. Ravens (*Corvus corax sinuatus*) and magpies (*Pica pica hudsonica*) are common in places, and the cañon wren (*Catherpes conspersus*) was found near Shoshone Falls in the lava cañon of Snake River.

The most common diurnal mammals are the Great Basin or sage chipmunk (*Tamias minimus pictus*) and a small spermophile (*Spermophilus townsendii*). Other equally characteristic species are the nocturnal kangaroo rat (*Dipodops ordii*), pocket mouse (*Perognathus olivaceus*), grasshopper mouse (*Onychomys leucogaster brevicaudus*). Four species of rabbits, namely, the white-tailed and the black-tailed jack rabbits (*Lepus campestris* and *L. texianus*), the Idaho pigmy rabbit (*L. idahoensis*) here described for the first time, and the great basin cotton-tail (*L. silvaticus nuttallii*) are common. Antelope roam over the plain in small herds, and badgers and coyotes are abundant. In the lava cañon of Snake River, near Shoshone Falls, the plateau lynx (*Lynx baileyi*), raccoon (*Procyon lotor?*), little striped skunk (*Spilogale saxatilis?*), dusky wood rat (*Neotoma cinerea occidentalis*), and cliff mouse (*Hesperomys crinitus* sp. nov.) are common, and tracks of porcupine (*Erethizon epixanthus*) were seen. Black-tailed deer (*Cariacus macrotis*) inhabit the cañons in winter.

Rattlesnakes (*Crotalus lucifer*), horned toads (*Phrynosoma douglasii*), and small lizards (*Sceloporus graciosus*) are common on the Snake Plains, and extend north through the principal sage-covered valleys. Two Bull snakes, provisionally referred to *Pityophis catenifer* by Dr. Stejneger, were collected at Big Butte and Arco, and a single *Bascanion vetustum* at Big Butte.

Salmon and sturgeon ascend Snake River to the Great Shoshone Falls. When we crossed the river at Lewis Ferry, October 15, we saw several large sturgeon (*Acipenser transmontanus*) tied by the tails to stakes driven in the bank. One weighed fully 70 kilograms (150 pounds), and we were told by Mr. Lewis that he sometimes catches individuals weighing as much as 300 kilograms (600 pounds). He told us also that a fall run of salmon reached his place about October 1, and that the fish that do not die go back in November. We met a number of Shoshone or Bannock Indians on their way to the river to spear salmon. Some of them came all the way from the Lemhi Reservation.

A kind of mole cricket locally known as the Idaho Devil (*Stenopelmatus fasciatus*) is common on the Snake Plains in

October. It is a large wingless insect with a great yellow head, powerful jaws, and a banded abdomen. I first saw it in eastern Idaho in October, 1872, and found it common from Shoshone Falls and Lewis Ferry to the head waters of Bruneau River in October, 1890. It lives in burrows in the sage plains and its holes resemble those of the small pocket mice (*Perognathus olivaceus*) in being clean cut, going straight down at first, and having no mound at the opening. In crossing the plains during cold stormy weather the heads of these curious animals were often seen at the mouths of their burrows and many were met with walking about among the sagebrush. They walk much, with seeming dignity and deliberation, and their tracks may be seen in every direction. If two are held together they immediately bite off one another's legs and inflict other serious wounds.—From *Animal Life.*

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RECENT LITERATURE.

Kuntze's Revisio Generum. II.—(*Continued from the February number, p.* 147.)—Section 10 discusses the difficulties arising from the almost simultaneous appearance of new publications, publications of uncertain date, incompleteness of libraries, etc.

Section 11 is entitled "Bentham and Hooker's Genera Plantarum and their neglect of the literature before Robert Brown." Kuntze is not the only one who has criticised Bentham for this, (G. J. Britten's Journal of Botany 1888, p. 261,) but Kuntze is especially severe upon him, not only for this, but for his method of changing species-names. He pays a high tribute to Bentham for his work in limiting and defining genera, but says (*in English*, § 16): "Surely Bentham was a genius of botanists, therefore I admire him, but he was a great sinner in nomenclature, who worked stupendously, but did not lose time in looking out for the rights of older authors and priority of their given names. He was a little ignorant of the authors of the past century; he took for instance.....Patrick Browne for ante-Linnean, although this botanist had adopted (1756) the Linnean system of 1735 with little alteration.....In the Genera Plantarum he has forgotten several thousands of generic names of Linnean and post Linnean time. He opposed the new international rule so as not to be obliged to correct himself innumerable times." Elsewhere he says, speaking of Bentham and Hooker: "Their nomenclature is to be censured not only because it is very incomplete as pointed out, but also because it builds wider upon the corrupt nomenclature of Robert Brown. The many inconsistencies and caprices in the choice of names in B.H.g.p. is to be deplored."

The truth of Kuntze's remarks will not be disputed. The English, as he says, admit it, but reply with the characteristic answer, "in our country we like to do so." So too, they like to measure with yards, feet and inches. Science is international or rather supernational, and it is not to be kept back by the prejudices of any nation. We may expect English botanists to cling to the methods of the "*raubritter*" period for a long time to come. But the world is not to be ruled by the heirs of Robert Brown.

The next section, 12, deals with the "*bequemlichkeit-motiv* as a hindrance to the restoration of rightful names." This "*bequemlichkeit-*

motiv" is the excuse constantly put forward by those who do not like to take all the consequences of the rule of priority. But like other vague principles its operation is somewhat capricious, and in practice is only applied where it suits the convenience of those who follow it. Bentham and Hooker, says Kuntze, follow it very inconsistently. In fact, he says, it is largely a patriotic motive, and they generally forget it in the case of their countryman Lindley. He gives some examples of Lindleyan names restored by them, and continues: "Lindley was one of the above mentioned companions of the Brown-Smithian clique which worked with Bentham on Wallich's catalogue 1829–31." He then speaks of the way in which authors in one country neglect foreign authors, and charges that the English and French "on the average overlook with great consistency everything written in the German language." Each nation too, "pushes to the front *nolens volens* its own authors," and he adds "we Germans are not entirely without this patriotic weakness." In these remarks he has struck the key note of the "*bequemlichkeit*" excuse. As he says, it is "directly opposed to the principle of order. If it is not given up, we shall revert to the condition before Linné, when each school or each land had a different nomenclature."

In section 13 he considers what should be the starting point for genus-names. He claims that there is no generally recognized *fixed* starting point. In general, Linné's last names are used together with those names given by his contemporaries which he adopted or did not rebaptize. But in some instances authors have gone back of his last names. Bentham and Hooker, he says, used the 1767 edition of Linné's *Systema*, not because they attached special value to that edition, but because they had no earlier one. Kuntze takes the editio princeps of Linné's Systema Natural (1735) as the starting point for genera, and explains his reasons at some length. In the first place he objects strongly to the citation of Tournefort for genera adopted from him by Linné. If Tournefort is cited, he says, why not Rivinus? And why not cite the authors between Tournefort and Linné whose names the latter adopted? It is, he says, making too great a leap to start with Tournefort, and then pass over all intermediate authors and start again with Linné. Some fixed point must be had and everything beyond rigidly excluded, or there will be no fixity in nomenclature. The citation of Tournefort arises, he says, from pietism and a little French patriotism. "Tournefort was shoved forward by De Candolle,.....but De Candolle and his followers ought first to have troubled themselves about the generally neglected contemporaries of

Linné, and have it yet to do before they make so long a leap backward."

The remainder of his argument is, in effect, as follows: The genus-nomenclature before Linné was very crude. Barbarous vernacular names, double names, as Barba-Jovis, etc., names in *opsis, pseudo*; etc. abounded to an intolerable extent. In his Flora Lapponica, Linné outlined to some extent, but only to some extent, the system and reform which he introduced in his *Systema Naturæ* of 1735. After 1735 the changes which Linné made in genus-nomenclature were for the most part capricious and made to confound or punish his contemporaries. It cannot be said that any of his works has been taken as the starting point. He made many changes for various reasons during his life, and his pupils and editors took his latest changes and handed them down, though some of them have not been followed. The foundation of modern genus nomenclature was permanently laid in 1735. All changes thereafter were in the details only. For these reasons Kuntze claims that this edition is the "only one which has a rightful claim to be the starting point." "There is," he says, "no rightful or moral ground for pushing aside the first and fundamental work of Linné." Accordingly he lays down two rules:

"1. Linné's *Systema Naturæ, editio prima princeps*, 1735, stands as the first consistently carried out Linnean system of nomenclature and system of genera; the work of 1753 for the first consistently carried out Linnean nomenclature for species."

As there is some doubt as to the exact time of the year at which the work of 1735 appeared, he adds: "2. In order to have an undoubtedly firm basis and a certain point of time for the beginning of our nomenclature, I have cut out from competition all the publications of other authors appearing in 1735 and bearing 1735 on the title page, and have allowed it (the competition) to begin first with the end of 1735—beginning of 1736, on the foundation of Linné's *Systema* I."

Admitting that there is no "moral" ground for pushing aside the edition of 1735, it remains to be seen how far there may not be practical grounds for so doing. This question he does not sufficiently consider. Many of Linné's later names, whatever motive may have led to their introduction, are great improvements upon his earlier ones. His last names have become firmly established, and there are good reasons for tolerating in him, the founder of nomenclature, some things which we need not countenance in his successors. We can take Linné's last names for the purpose of getting a fixed and permanent nomenclature without committing ourselves to submission to the

yoke of Robert Brown and his successors. But if authors go back to Linné's last names at all, there should be some fixed point beyond which they are not to go, and at which citation should stop. The adoption of the 1735 edition does not require as large a number of changes as one would suppose—indeed the number is relatively very small, and it certainly has the advantage of furnishing a certain, unmistakable and eminently logical foundation for nomenclature.

Section 14 is devoted to a number of proposed additions and amendments to the international rules, which make them more strict and definite, and modify some of them in accordance with his views as explained in the preceding sections. They are of such length, that but a few can be noticed here.

He proposes to amend article 51 by striking out the words "higher or" and adding at the end of the article "on elevation of a group, the author who founded the group should be cited, either alone with a § mark preceding, or with the other author behind in the second position." The last is of course to avoid what he calls "seduction." His object in making the change is to get a citation that will indicate clearly the origin of the name, so that there can be no doubt as to its validity against intermediate names. But he makes a distinction between the elevation and the reduction of a group, claiming that his rule should apply to the former only, and that in the latter case the correction only should be cited, and he argues this at some length. His reason is that to extend the rule to both cases would encourage undue haste and radicalism. So on the other hand, it may be said that his restricted rule put a premium upon undue conservatism, which sometimes does not demand much deliberation. His idea seems to be that a writer should feel that he describes species under new genera at his peril. It is somewhat inconsistent with his principles to allow any possibility of confusion for the purpose of chastizing genus-mongers; and it cannot be denied that intermediate names must be guarded against as much in one case as in the other. Throughout the book he is conspicuously hostile to genus-division. In this instance he seems to have carried his zeal too far.

In article 60 he proposes to strike out paragraphs 3 and 4, which he adds to article 28, and to substitute 11 paragraphs giving forms to be rejected. Of these 10 is "double genus-names," with three exceptions however, of which (b) is "personal names put together which result in a flowing word." This is not exactly consistent. How much worse are double genus-names than "flowing words" (!) like "Sirhookera," "Hallowmullera", etc?

His eleventh paragraph is: "In case of halves of separable ancient genus-names, if the first word is valid and capable of standing alone, and is not the name of a higher group, then the first word stands. Accordingly he gives us "Bursa" for Capsella, and our common weed he writes "*Bursa pastoris* Wigg."

To article 66 he adds: "Names which rest upon unlike orthography or are only to be distinguished by the presence or addition of final syllables, only stand as different words when they differ in one unlike *consonant* standing between two vowels or lacking in one of the words." He then proposes an addition to the effect that vernacular names and the younger of two pseudo-homonymes (e. g. Apium L and Apios Moench., within his rule) be adopted and Latinized or altered, as the case may be, by the addition of two or three letters; e. g. Vochy Aubl. he makes "Vochysia Aubl. corr. O. K.;" Apios, "Apiosus Haller corr. O. K." He lays down some more exceptions and additions, which are quite strictly formulated, and finally proposes this: "Permissible name corrections do not warrant the citation of the correcting author in the first place, either for genera or for the names of species to be joined therewith." He also lays it down that names like Heurckia and Vanheurckia, Candollea and Decandollea must stand as distinct. I believe I am justified in saying, however, that Saccardia (or as he writes it Saccardoa) and Pasaccardoa or Marckia and Lamarckia (both of which stand under his rule) are much more likely to be confused in practice than Apios and Apium, certainly more so than Capnodes and Capnodium, which conflict under his rule, so that he rejects the latter. Besides his "corrections" (as Apiosus) are fatal to the meaning of a name, and as a rule add nothing to its sound. It is all very well to have strict rules here as elsewhere, but there is room in this place for the application of a little common sense.

A suggestion which he makes for a new article is interesting, and will not seem unreasonable to those who have tried to deal with works in Polish or Hungarian which sometimes appear. It is: "Article 69. Publications are only admissible for competition for valid nomenclature so long and so far as they are printed in Latin characters and appear in the Latin, English, French or German languages; but for gothic characters this has no retrospective force." To be strictly just this should include Italian; in other respects the rule is desirable.

Section 15, additions, etc., to Pritzel's Thesaurus and § 16, a vigorous and well written article in English on "Modern English Nomenclature" close the introduction.

The revision itself follows, the genera in each family being taken up alphabetically. Details of all kinds abound in notes, etc., and are often very interesting (e. g., notes on proper spelling, on botanical Latin, etc.). But no confusion is produced by them or the revisions of genus-limits and monographs scattered through the work. One thing might be mentioned. He unites Aster and Solidago and intermediate groups in the genus Aster, giving quite a full discussion of his reasons. He also works out the proper species-name combinations whenever he changes a genus-name. Many things might be commented upon did space permit, but the introduction indicates the nature of all the changes.

Just what the effect of the work will be cannot be foretold. Many of the suggestions will hardly be adopted. Others, it is to be hoped, will be. As the most thorough piece of work yet done in a direction now receiving much attention it must have some influence. Certainly the admirable discussion in the introduction of the defects of our present nomenclature and the causes of them cannot fail to have considerable effect, and constitutes the most valuable part of the work. The author appears in the introduction as a keen and severe, yet on occasion, appreciative critic, and if we are to believe his statement that he worked from thirteen to fourteen hours a day for the last three years, no one can charge him with haste, or say as he does of Durand, that he has not put time enough upon his work.

One acquires a good deal of prejudice against the book on first glancing it over, which disappears on a more thorough reading of the introduction. Paradox as it is, the only way to attain an unchangable and uniform nomenclature is to make changes now with an iron hand. "Unambiguous rules and priority," as he ever says, "are the only sound principles by which we can bring order in [to] nomenclature. The changes necessitated by priority should.....be made as promptly and as thoroughly as possible, and—as we may wish it—if possible at once, in one book.—Roscoe Pound, *Lincoln, Nebraska, February* 8, 1892.

Literature of Parasites, No. II.—M. Braun. "Die sogenannte freischwimmende Sporocyste." (Centralblatt f. Bakl. u. Par. 1891, X 7, p. 215–219.)

In 1885 Prof. Ramsay Wright, of Canada, found a peculiar free-swimming organism which he considered to be a free-swimming sporocyst. Prof. Braun, of Königsberg, recently found some similar organisms, which he traced to *Limnaeus palustris* var. *corvus*. Braun dif-

fers, however, in his interpretation of these organisms from the views advanced by Wright and afterwards accepted by Leuckart, in that he considers that we have in this case not a sporocyst stage but a *cercaria stage, in which the anterior portion of the body (the Distoma) has crawled into its own tail.* He has given the name *Cercaria mirabilis* to the larva, but is as yet unable to tell to what species of Distoma it belongs. Prof. Braun's view seems to be the correct one, as he examined the organism in various stages of development.

Dr. Raphaël Blanchard, " Histoire Zoologique et Médicale des Téniadés du genre Hymenolepis (Weinland)." Prof. B. begins with a former review of works on this genus, dwelling at some length on Grassi's experiments, in which the latter showed that *H. murina* has an indirect development *without* change of host.

The embryo enters the villosities of the intestines, where it develops into a cercocystis, which afterwards becomes free in the lumen and develops into the adult tape-worm. This is the only case where it has been demonstrated that a Tænia can pass its full development without change of host.

Blanchard's diagnosis of the genus Hymenolepis is as follows: Body small, filiform; head small, provided with a retractile rostellum—well developed and armed with a simple crown of 24–30 minute hooks or rudimentary and unarmed; neck long; segments serrated, much wider than long, in number rarely less than 150. Sexual pores marginal, piercing the left border, the ventral face being that which is occupied by the female genital organs. The male genital apparatus contains a very small number of testes, generally but three, two of which lie in the right half of the segment, the third in the left half. Mature segments transformed into a sack full of round or oblongated clear eggs; there are three concentric yet separated egg shells. The internal shell contains the oncosphere (six hooked embryo), possesses no pyriform apparatus, but sometimes shows a papilla at each pole. The larvæ is either a cryptocystis (cercocystis) or a staphycystis. Development is indirect, either without change of host, but with a migration from one organ to another, or more frequently with change of host, the intermediate host being an insect or myriapod.

A list is then given of all the know species (14 according to Blanchard), their hosts, intermediate hosts and larval forms, so far as known. Blanchard is not ready to accept Grassi's view that *H. murina* of the rat and *H. nana* of man are identical.

The latter half of the book is given up to the more purely medical side of the question. Diagnosis, symptoms, treatment, etc.

H. nana has been found in man in Egypt, England, Italy, United States of America and Argentine Republic. *H. diminuta* (*flavopunctata*) in America and Italy.

Complete bibliography of the genus follows.

The work is well done and like most of his work exhausts the subject up to date.—C. W. STILES, *Washington, D. C.*

EDITORIALS.

EDITORS, E. D. COPE AND J. S. KINGSLEY.

—The address of Prof. Kölliker as President of the Munich meeting of German Anatomical Society contains some words which are deserving of repetition in this country.

Referring to the literature of Anatomy, he expresses the wish that all morphologists would agree to publish their observations only in one of the four best-known languages, and at the same time that it is desirable that all anatomical contributions should appear in a few specified journals. He makes the following suggestions: (1.) Every author who writes in another language than English, French, Italian or German should provide, as is already often the case, a short abstract in one of these languages. (2.) It would be of great value if every country possessed a journal which should give as soon as possible a short abstract of every paper which appears outside of the special journals. It is often the case that important papers lie long buried in society transactions which would thus have their value and significance placed before the public. A few words follow upon the possibilities of a universal language, in which the claims of Volapük and the like are dismissed in short order. "The savants of the middle ages possessed a genuine universal language in the Latin, and it is only in such wise that one is possible to-day; in such connection English or French are first to be thought of."

The rapid advance of English to the position of a universal language has attracted the attention of all students. English is spoken to-day by over 125,000,000 people; no other language of Europe, excepting the barbaric Russian, is spoken by half that number. English has an additional claim from the ease with which it can be learned. It has developed further (has degenerated, if you will) in that it has largely lost its inflections, and this fact has added not a little to its simplicity and to the facility with which it may be acquired, while its capacity for adopting Latin and Greek roots is an important element in its favor.

Another word in relation to the address of Prof. Kölliker. There is to-day no other journal in America which offers itself for the publication of preliminary communications in all departments of natural science; there is none other which attempts to give abstracts of work published elsewhere. Our readers know what we have done in this respect in the past; we feel that we can promise that the NATURALIST will in the future excel its past so far as this department is concerned.

—A COMPARATIVELY small number of persons, even in intelligent communities, regard scientific pursuits seriously unless there is some financial consideration attached. To the habitual cultivator of science or other ideal occupation, the devotion of the majority of mankind to money getting seems like a misfortune. The philosopher, however, knows that were men relieved of this necessity, the majority of them would be still less profitably employed, and the race as a whole would degenerate. Nevertheless the number of men who believe it to be true, that the pursuit of pure science and philosophy are necessary to human development, is increasing. But of this enlightened class a considerable proportion appear to think that human knowledge will grow of itself like grass, and that artificial aid is unnecessary. These remarks are made apropos of a phenomenon frequently observed in the city where this journal is published, and we have no reason to suppose that other localities differ from it in this respect. A dance or a dinner party is a most successful rival of an emergency to be met at a meeting of a society devoted to the pursuits of science or philosophy. Where the heels or the stomach have the call, the brain has to retire into "innocuous desuetude." The limited revenues of science may be misappropriated or absurdities perpetuated in her name, while her alleged patrons cultivate less important matters. Dinners and dances may be indefinitely repeated, but action by corporate bodies is only lawful at stated times, and the results of such action are far-reaching, both in scope and time. With a higher civilization we will respect our brains more and our stomachs less, and still have a mutual understanding between brains and stomach which will be beneficial to both parties.

—GENERAL ISAAC T. WISTAR, President of the Philadelphia Academy of Natural Sciences, has added his name to the honorable list of those who have given pure science a permanent endowment. He has placed in the hands of trustees for the benefit of the University of Pennsylvania, $100,000 for the erection of a museum with laboratories, to contain the Wistar and Horner Museum of Human and Comparative Anatomy, and has added an endowment of $3,000 per year for the maintenance of a curator, whose occupation shall consist largely of original research. Although there are several positions in Philadelphia occupied by distinguished investigators, this is the first permanent endowment distinctively devoted to this purpose which we have.

—THE newspaper press announced a few months ago that the Agricultural Department of the U. S. Government had determined to introduce the mongoose into the West to exterminate the rodents which annoy the farmers of that great agricultural region. Among other protests sent to Washington against this proposition, was one written by one of the editors of the NATURALIST. The following reply was received:

DEPARTMENT OF AGRICULTURE,
WASHINGTON, D. C., Feb. 8, 1892.

DEAR SIR: Replying to your letter of the 7th inst., respecting the introduction of the mongoose into the United States, I beg to say that this department has never contemplated any such rash act, the introduction of exotic species being contrary to the policy of this department.

Respectfully,
EDWIN WILLITS,
Assistant Secretary.

This reply gives us great pleasure, since evil has almost invariably resulted from the introduction of exotic animals into countries when no adequate natural restriction to their increase exists. It should be the duty of an Agricultural Department to impress on our farmers and others the importance of preserving the natural balance of life in the country as nearly as possible. If insectivorous birds are destroyed, vegetation will be overrun with insects. If the snakes are destroyed the smaller mammals will increase indefinitely. A good deal of pains is taken to protect birds in some of the States, but none whatever to protect the harmless snakes. These animals are the natural destroyers of the rodents, moles, etc., which are so destructive, and they inflict absolutely no injury. Yet one can hardly open a newspaper without reading of some men or boys who have found a den of snakes and have as a matter of course destroyed every one of them. This is not only a crime, but a blunder, and the grade of a man's intelligence is low who allows himself to commit it.

—PROF. BURT G. WILDER, in a recent paper, makes a good suggestion. All naturalists make mistakes, and he proposes that each writer, either as soon as he finds some error in some of his published work, or periodically, have a public confession of sins. It certainly is more agreeable to acknowledge one's faults than to have some stranger, often in the most polemical manner, point out all of our sins of omission or commission.

—The Naturalist has again changed publishers, and we hope that we will not again have to undergo the ordeal. The numbers can now be issued at the proper time if subscribers will be equally prompt in making payments. The number for December, 1891, was issued Feb. 1st, 1892. The late publishers failed to state this on the last page of that issue as requested by the senior editor.

General Notes.

GEOGRAPHY AND TRAVEL.

Recent Australian Exploration.—It was believed early in this century that the wholly unknown interior of Australia was watered by a great river system reaching the sea in the deep bays of the northwest part of the continent. It was to establish this supposed fact that Capt. Sir Philip King sailed along this coast in 1820, entering all the deep inlets to find some great river mouth. One day he sailed twenty-five miles up Hanover Bay, discovering a large river which he named the Prince Regent. The next year he ascended the river for fifty miles. Nearly seventeen years elapsed before another expedition under the command of Sir George Gray, was sent to Hanover Bay to complete the exploration of the river. The natives fell upon the party and wounded its leader so badly that he hastened back to civilization. From that day until last year no further effort was made to solve the problem of the Prince Regent River.

The latest *Petermann's Mitteilungen* contains a report of the expedition led a year ago by Mr. Joseph Bradshaw, of Melbourne, through this wholly unknown part of Australia. Landing at Wyndham, on Cambridge Gulf, with four white companions and two natives and a supply of provisions carried on pack horses, the little party plunged southwest into the unknown wilderness towards Prince Regent River. They had not gone far before they met natives as wild as any that were ever dismayed by the apparition of white men. The savages living along one river plunged into the water and swam across the stream upon the approach of the expedition.

Nearly all the way to the Prince Regent River the party traveled through tall grass. One species known as the black oat grass was from nine to twelve feet high, and it was difficult for the little caravan

to force their way through it. At one place, where many enormous sandstone blocks were scattered over the plain, they found numerous large holes excavated in the boulders in which the natives had stored the bones of their dead. The skeletons were not preserved intact, but the bones were packed closely together, and large stones covered them, apparently to prevent wild dingoes from scattering them. These curious mausoleums were found along a creek which Mr. Bradshaw named Sepulchre Creek. Here also he found a hitherto unknown fish of fine flavor which he was not able to find in any of the other rivers. He proved that the great desert of inner Australia does not extend thus far to the northwest, for the region through which he passed was watered by scores of creeks and rivers, while tropical vegetation luxuriantly flourished.

One day the party came to an unexpected impediment. A wall of high hills rose so precipitously that it was impossible to lead the horses up the slope. After hours of search a narrow valley was discovered between whose steep, high sides they traveled for about a mile until they reached the summit of a comparatively level, well-grassed plain. On this plateau they traveled for several days before they descended on the other edge. They found it very difficult to get through the tangle of hills bordering this little plateau on the western side, and for four days they were busy with axes under the glowing heat of the tropical sun cutting a road for the horses. A little beyond they ascended a mountain about 1,500 feet high, from which a very fine prospect extended from all directions.

On all sides stretched away the hills of lesser elevation, covered to their tops with thick growing grass, while as far as the eye could reach could be seen a great abundance of lagoons and watercourses fringed with papyrus and palms. It was a fine tropical prospect and very different from the semi-arid region which must begin not a great distance to the southeast.

Mr. Bradshaw was particularly struck with the work of white ants in the western part of the region he traversed. In one place, for instance, he discovered a perpendicular pillar with a diameter of about three feet and nearly ten feet in height. It stood in the middle of an enormous rock, at least forty feet from the nearest bit of soil. All the material for this structure must have been carried by these little insects forty to fifty feet, involving enormous labor.

As the party neared the Prince Regent River the country became more difficult to traverse on account of the steep hills, the great blocks of porphyry and sandstone in their way, and the tall grass.

Sometimes they traveled for hours up a valley to find that it was cul de sac, and all their labor was lost. At last they struck the Prince Regent River, and here they found many natives, doubtless the children of those that had attacted Sir George Gray. They were very shy, and were painted with red and white stripes in a wonderful manner. Many of them wore a curious headdress made of papyrus. As weapons they carried spears and nullis, as well as bows and arrows, but no boomerangs were seen.

The Prince Regent River was reached just a little above the point attained by Sir Phillip King. In a straight line they were about 150 miles from their starting point, but they had traveled nearly double that distance. It is a beautiful river, about 200 feet wide at the place where Bradshaw struck it, and its waters coming from the Leopold Mountain chain, which is marked on the maps, are cold and refreshing. The party ascended the river, only to find that about a day's journey above the place attained by Sir Philip King a splendid waterfall puts an end to navigation. This waterfall extends from bank to bank and the entire volume of water has a perpendicular fall of thirty feet. They traveled for five days along the river bank above the waterfall to mountains through which the river flows, and along the rocky walls that hem in the narrow river they found many caverns on whose walls the natives had made paintings in red, black, white, brown, yellow, and light blue. There were figures of men with profiles well drawn, and kangaroos, wallabies, crocodiles and other animals were graphically portrayed.

The noteworthy discovery was made that for a distance of fifty miles the Prince Regent River flows between two entirely different rock formations. The right shore is composed of basaltic rocks and the left is sandstone. The territory on the right bank is well wooded and grassed, while on the west there is found mostly only prickly spinifex and black oat grass with boulders strewn over the country.

Mr. Bradshaw was well satisfied with the result of his journey. His purpose was to ascertain if this region was adapted for cattle raising. He has satisfied himself fully that ranches can be established to good advantage at many places between the northern coast and Prince Regent River. South of the river vegetation changes its character and doubtless merges at no great distance into the almost verdureless expanses of the great thirst region of inner Australia. His party was very short of provisions before they got back to Cambridge Gulf, where they arrived on May 14. They, however, eked out their rations with wild turkeys, kangaroos, iguanas and fish, and at Cam-

bridge Gulf they were glad to find again some of the comforts of civilization in the huts of the hospitable Chinese who occupy the most advanced post of civilization in that region.

Bradshaw's journey has revealed the character of one of the large unexplored regions of Australia. About the same time David Lindsay was crossing the greatest unknown expanse in southwest Australia. He has now gone north to traverse an unexplored district in the west central part of the continent, and when he completes this journey there will be no large region in Australia that is not fairly well known in its general aspects.—*N. Y. Sun.*

GEOLOGY AND PALEONTOLOGY.

The Genus Scolithus.—Mr. Joseph F. James read a paper before the meeting of the Geological Society at Washington entitled "Studies in Problematic Organisms—The Genus Scolithus." After a lengthy review of the literature concerning this subject, the author discusses the fossils as follows:

"There have been described of the genus from North America the following species:

Scolithus (*Fucoides*) *shepardii* Hitchcock, 1833 (Triassic).

S. linearis Haldemann, 1840 (Lower Cambrian).

S. (*Fucoides*) *verticalis* Hall, 1843 (Portage).

S. clintonensis (n. sp.), proposed for *S. verticalis* Hall, 1852, preoccupied (Clinton and Medina).

S. canadensis Billings, 1862 (Potsdam).

S. minutus Wing, 1877 (Calciferous).

S. tuberosus Miller and Dyer, 1878 (Cincinnati).

S. (*Arenicolites*) *woodii* Whitfield, 1880 (Potsdam or St. Croix).

S. delicatulus U. P. James, 1881 (Cincinnati).

S. dispar U. P. James, (*Eophyton dispar*), 1881 (Cincinnati).

S. minnesotensis (n. sp.), Winchell, 1884, described but not named (St. Peters).

The geological range of the genus appears from this list to be from the Lower Cambrian to the Triassic. *S. shepardii* from the Triassic does not differ in any essential respect from *S. linearis* from the Cambrian. It is impossible to separate *S. verticalis* of the Portage from *S. clintonensis* of the Clinton and Medina, or either of these from *S. linearis*. As we have already shown, *S. canadensis* and *S. linearis*

may be considered identical; while *S. minutus* from the Calciferous and *S. woodii* from the Upper Cambrian of the Mississippi Valley may be said to be separable by no definable characters. *S. delicatulus* from the Cincinnati differs from *S. minutus* only in having the cavities of the tubes filled instead of being hollow. Finally, *S. minnesotensis* from the St. Peter is the same, so far as characters go, as *S. linearis* from the lower Cambrian.

It cannot be considered as at all probable that the annelid living in the lower Cambrian and making the perforations we know as *S. linearis* persisted in the same form through all later geological periods into Triassic time. Mr. Walcott does not think it probable that the same species ranged even through Cambrian time, to say nothing of a much greater time-range. Yet he places forms from the lower and from the upper Cambrian under the same specific name. On the same principle we should unite all the species, in whatever geological horizon they may occur, under one name, for there are no characters to distinguish one from another. But this does not seem advisable, and under the circumstances I would propose that the geological position shall decide the name to be used. Thus, *S. linearis* might be applied to forms from the lower Cambrian rocks of the eastern United States; *S. canadensis* to those occurring in upper Cambrian strata of the eastern United States, and *S. woodii* to those from strata of similar age in the upper Mississippi Valley; *S. minutus* might be the name for the form in Calciferous strata; *S. minnesotensis* might be applied to the forms from the St. Peter, and *S. delicatulus* to those in Cincinnati rocks; *S. clintonensis* might be applied to those from Clinton and Medina strata, *S. verticalis* to those from the Portage, and *S. shepardii* to those from the Triassic. It is probable, also, that a name should be given to forms collected from other horizons, say *S. arizonicus* to the form from the Grand cañon in Arizona.

Several objections may be urged against such an arrangement. One of these is that it robs the genus of all value as indicating the age of the rocks in which it occurs. This is true. It deprives *Scolithus*, too, of any value as a means of correlating rocks of two different sections, one with another. This is also true, and so it should be. No valid argument can be brought forward to justify placing the rocks of two widely separated areas in the same terrane upon the evidence of such a form as *Scolithus*—a form of indefinite character, of indefinable features, of perplexing variability, and of wide time range. The use of forms of this sort as a means of correlation is even worse than the use of lithological characters. Time does not permit mentioning the

erroneous correlations resulting from the use of *Scolithus*, but they are numerous enough.

The second objection urged will probably be the multiplication of names resulting. Some will, perhaps, prefer to let *Scolithus linearis* do duty for all the forms if they can be shown to be indistinguishable, but this objection does not seem to me to be a valid one. Dr. C. A. White, in a paper read before the American Association for the Advancement of Science last year and published in volume 39 of the Proceedings, in speaking of applying new names to fossils occurring in two different formations, says that "if a given formation is found to bear a fossil fauna the component members of which, with such exceptions as have been referred to (i.e. forms considered identical in two formations) are all unlike those of any other known fauna, I think it admissable to treat the whole fauna as new and to give a new name to each species" (p. 242). My own studies of *Scolithus* led me to adopt this method previous to reading Dr. White's paper, and I have therefore proposed, as seen above, to characterize the species of *Scolithus* upon the formation, and not, as has been done at times, the formation on the occurrence of the species."

The paper by Mr. James was discussed by N. S. Shaler and E. W. Claypole. Professor Shaler advised neglecting altogether the specific names for *Scolithus*, since it is at best only a hole in the rock. He also regarded Billings' observations on sponge spicules as valueless, because anything so widely distributed as these spicules would be swept into small crevices or openings, such as the *Scolithus* perforations. Professor Claypole remarked that *Scolithus* persists to the present time.

The Sirocco as a Disintegrating Agent.—Mr. John B. Cooke cites a number of facts (Science-Gossip Jan. 1892) to show that the sirocco is an important agent in planing down and molding the hills and valleys of the Maltese Islands. Its effect may be traced on every rock and boulder. Of the exteriors of walls and houses, the side that is exposed to the sirocco always presents an eroded and time-worn appearance, while the other sides are fresh and unworn. It is not uncommon to find stones almost completely worn through. In the old fortifications that were erected by the Knights of St. John, such phenomena are of frequent occurrence. From a series of calculations of the rate of the erosion of the Globigerina Limestone in a number of buildings of known ages, Mr. Cooke estimates the denudation due to the sirocco at 22 tons of material annually from every acre of surface.

Vertebrate Fossils at Samos.—At a recent meeting of the Academy of Sciences of Paris, M. Forsyth Major gave a very nearly complete list of the fossil vertebrates found at Samos. Of the forty-three species of mammals discovered, twenty-five at least were equally represented at Pikermi, thirteen at Maragha, seven at Baltavar and seven at Mount Léberon, so that the inference is that these different formations are probably of the same geologic age.

In fact, the author has remarked, in a new communication to the Academy, that this fauna can now be traced continuously from Spain to eastern Persia, thus proving continental conditions; so true it is that a marine equivalent is not found in these countries. The uniformity of the fauna suggests a uniform environment, and especially of climate throughout this great tract of country. Also, the vast number of horses and ruminants reveals the existence of plains or plateaus of wide extent. All these conditions permitted the distribution of the animals over an enormous area in a comparatively short time, and the mingling of individuals from localities far distant from each other would be another factor preventing a tendency to vary. (Revue Scientific, 28 Nov., 1891.)

Geologic Correlation by Means of Fossil Plants.—In a paper read before the American Association for the Advancement of Science at Washington, Aug. 21, 1891, Mr. Lester F. Ward showed what an important factor is Paleobotany in the determination of the age of deposits widely separated, as well as more nearly related formations. For this determination, however, it is necessary to have a body of facts; i.e. a fair series of good specimens. He instanced, as examples, the beds of Chardonet, referred by Elie de Beaumont to the Mesozoic which are now known to be Carboniferous. Or, coming nearer home, the clays of Gay Head, Mass., which geologists had described to be of tertiary age, until the discovery by Mr. White of a bed of fossil plants which proved to be types of the Amboy clays of New Jersey, and therefore represent the Cretaceous.

In order to make use of the principles of Paleobotany in geologic correlation, Mr. Ward proposed the preparation of tables of distribution, (1) American, (2) Foreign which should contain (a) identical and (b) related species. The fact to be borne in mind is that correlation established by such data is homotactic and not necessarily chronologic. (Am. Geol. Jan. 1892).

MINERALOGY AND PETROGRAPHY.[1]

Petrographical News.—Chrustschoff[2] has re-examined the rock of Island Wallamo, in Lake Ladoga, Finland, that was first described by Kutorga as a crystallized labrador-granite. Two varieties were recognized by Chrustschoff, the one a dark-brown dolerite, composed essentially of tabular plagioclase, idiomorphic pyroxene, olivine and a little glass, with sanidine surrounding the plagioclase, and quartz crystals embedded in micro-pegmatite, occurring in the interstices between the plagioclase crystals. The second type is a dark-green diabase-like rock, whose constituents are the same as those of the first-mentioned rock. In this quartz and orthoclase are rare. These rocks are cut by narrow dykes and veins of granophyre, without peculiar features. In explanation of these phenomena the author states that the original rock was an olivine diabase that had solidified, with the exception of its glassy ground mass, when it was intruded by granophyre. The acid magma partially dissolved the crystals and the unsolidified glass of the intruded rock, and so produced an orthoclase quartz aggregate. The basic plagioclase was corroded, and sanidine separated from the mixture formed by its solution in the acid magma, while the remaining acid material cooled as granophyre.——Deecke[3] gives a very detailed account of the geological and petrographical relationships of the gray tufa of the Campagna, Italy, which he believes to be a product of the volcanoes of the Phlegraean Fields. This tufa now consists of a colorless or pale yellow glass, in which are imbedded fragments and crystals of a very soda-rich sanidine, augite and biotite. The rock is thus an augite-trachyte. An analysis of the crystals of sanidine gave:

SiO_2	Al_2O_3	FeO	CaO	MgO	K_2O	Na_2O	Loss	Total
63.79	20.87	1.09	2.06	.41	7.56	3.72	.42	99.92

Besides the fragments of minerals there are also found enclosed in the tufa pieces of augite-trachyte, pumice and obsidian, fragments of hornblende-trachyte, and others of sedimentary rocks. A noticeable and very characteristic feature of the tufa that distinguishes it from others occurring in the same region, are the numerous geodes distributed in great numbers through its mass. These contain a yellowish powder, consisting of sanidine, tufa-fragments and fluorite. They are

[1]Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2]Geol. Fören. i. Stockh. Forh. 13, 1891, p. 149.

[3]Neues. Jahrb. f. Min., etc., 1891, I, p. 286.

supposed to have originated by the gradual decomposition of lapilli enclosed in the ash.——Hutchings[1] records the existence of tremolite and garnet in the flags at Shap, England, where they have been altered by the intrusion of granite through them. The tremolite is produced in the contact zone within the zone of spotted slates, and the garnet in about the same zone as the 'knoten,' but in different beds. The minerals producing the spots in the contact rocks are of different natures. In some cases white mica is the new product found, while in other cases it is probably andalusite. The clay slate needles that are present in large quantity in the unaltered flags continue to exist even in those rocks in which brown mica has begun to form. In the phases in which brown mica is abundant and newly-formed quartz is present the needles have disappeared, and in their place are found crystals and grains of rutile and sphene. In another stage of the contact action groups of large rutile crystals are observed, and in the neighborhood of spots are clusters of anatase crystals.——In central Siberia are mighty dykes and flows of basic rocks, among which Chrustschoff[2] recognizes ten types of augite—plagioclase—olivine rocks, containing more or less orthorhombic pyroxene and orthoclase. Their structure varies from the gabbroitic to the basaltic. Each type is described in detail and a photograph of it appears with the description. Even in the most glassy varieties well developed orthoclase exists. The principal structures noted are the gabbroitic, ophitic, with and without glassy base, anamesitic and aphanitic, with small crystals of feldspar. ——Mr. Rutley[3] describes very briefly a few sections of basalt or andesitic glass from Caradoc Hill, in Shropshire, Eng. At present the rock contains no olivine, but certain peculiar arrangements of magnetite grains indicate its former existence in them. With the glass are a basalt tufa and perlitic felsitic rhyolites with obscure flowage structure, and some with spherulites. An interesting spherulitic and perlitic obsidian is also described by the same author[4] from Pilas, Mexico. In this the perlitic cracks were certainly formed subsequently to the spherulites, and were afterwards filled with secondary silica and perhaps other substances.——Much of the so-called anthophyllite and actinolite in the rocks associated with the iron ores of the Lake Superior region is a monoclinic magnesian amphibole, corresponding to grü-

[1]Geol. Magazine, 1891, p. 459.

[2]Bull. d. l'Acad. Imp. des Sci., d. St. Petersb. Mél. géol. et paleont. T. I, p. 81.

[3]Quart. Jour. Geol. Soc., Nov., 1891, XLVII, p. 534.

[4]Ib. p. 530.

nerite, according to Messrs. Lane and Sharpless.[1] Its refraction is 1.7. It may easily be distinguished from actinolite by its polysynthetic twinning parallel to $\infty P\bar{\infty}$ and by its optical characteristics. It is colorless or pale green or brown, and is only faintly pleochroic. An approximately correct analysis gave:

SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	$(NaK)_2O$	H_2O
76.32	.56	.99	6.96	12.47	tr.	2.80

Fibres of riebeckite or crocidolite have also been discovered by Lane as a secondary growth on the primary hornblende of a syenite from the S. E. ¼ of Sec. 17. T. 49, R. 25, W. in Michigan.——The principal types of olivine and anorthite skeleton crystals in some of the Vesuvian lavas have been well characterized by Rinne[2] in an article illustrated by thirty-eight figures. The olivine skeletons are elongated parallel to the axis *a*. Many are twinned, giving rise to various crosses, in one of which, whose arms intersect at nearly right angles, the twinning plane is $\infty \breve{P}2$, a new twinning law for this mineral. Intergrowths of olivine and plagioclase were noted. The anorthite skeletons often show crystallographic faces in grains no larger than .07 mm. in diameter.——Mr. Turner[3] gives a brief account of the geology of Mt. Diablo, in California, describing incidentally a uralitized diabase containing twinned augite, and in some places passing over into a diorite whose hornblende may be secondary, peridotites (lherzolites), pyroxenites (websterite) and gabbros, each of which has given rise to serpentine. In a supplement to Turner's paper, Dr. Melville records the results of the analysis of these rocks together with those of sandstones, shales and a glaucophane schist from the same region. The composition of the schist is as follows:

SiO_2	P_2O_5	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	H_2O
47.84	.14	16.88	4.99	5.56	.56	11.15	7.89	.46	3.20	1.98

—A paleozoic leucite-rock, consisting of sanidine, augite, nepheline, and leucite, with the accessories anorthoclase, apatite, zircon and magnetite in a glassy base is mentioned by Chrustschoff[4] from a locality in Russia. The rock is aphanitic and resembles in appearance some of the Hohentwiel phonolites as well microscopically as in microscopic

[1] *Amer. Jour. Sci.*, Dec., 1891, p. 499.

[2] Neues. Jahrb. f. Min., etc., 1891, II, p. 272.

[3] Bull. Geol. Soc. Amer., 2, p. 383.

[4] Neues. Jahrb. f. Min., etc., 1891, II, p. 224.

structure. Sanidine phenocrysts, augite, anorthoclase and leucite lie in a ground mass of sanidine, nepheline and the other above-mentioned constituents.

Mineralogical News.—NEW MINERALS.—*Newtonite* and *Rectorite.*—Messrs. Brackett and J. F. Williams[1] suggest that the kaolinite group of minerals consists of four members, each containing one part of Al_2O_3, two of SiO_2, and one, two, three and four molecules of water respectively. The best-known of these are kaolin, with the composition $Al_2O_3\ 2SiO_2+2H_2O$, and halloysite, with an additional quantity of loosely combined water. The places of two other members they fill with the new minerals, newtonite and rectorite. The former occurs in lumps in a clay associated with the shales and sandstones of the Barren Coal Measures on Sneed's Creek in Arkansas. It is a pure white, soft, compact, infusible substance, with a density of 2.37. It is only slightly soluble in boiling HCl, but is easily decomposed by hot H_2SO_4 and by boiling NaOH. Under high powers of the microscope it appears to form rhombohedrons. Its analysis, calculated for the pure dry material, yielded $SiO_2 = 40.88$; $Al_2O_3 = 35.85$; Loss, $23.27 = Al_2O_3\ 2SiO_2 + 4H_2O$. Rectorite is found in veins in sandstone in the Blue Mountain District, about twenty-four miles North of Hot Springs, Ark. It is in soft white plates, closely resembling mountain leather. Its hardness is less than that of talc, and it is infusible. Upon heating it becomes brittle. The analysis, corrected for impurities, gives $SiO_2 = 54.67$; $Al_2O_3 = 37.22$; Loss $= 8.02$; or, if the excess of silica be regarded as an impurity, $SiO_2 = 49.99$; $Al_2O_3 = 41.16$; $H_2O = 8.84$; besides 8.78% of H_2O at 110°–115°. This corresponds to the first place in the series, viz.: $Al_2O_3\ 2SiO_2 + H_2O + Aq$. The index of refraction for the substance is low. It possesses two cleavages inclined to each other, and its acute bisectrix is normal to one of these. $\rho \quad \nu$. The crystallization is thought to be monoclinic. Tested in the kiln the substance shows properties quite different from those of kaolin.——*Plumboferrite.*—The discovery of this mineral was announced by Igelström as long ago as 1881, but since it has not been noticed in journals outside of Sweden the discoverer[2] reannounces his discovery in a recent article in German. The mineral belongs to the franklinite group, from the other members of which it differs in containing lead in place of zinc or manganese.

[1] *Amer. Jour. Sci.*, July, 1891, p. 11.

[2] *Zeits. f. Kryst*, xix, p. 167.

It is found at Jakobsberg in black, platy masses, with a red streak similar to that of hematite. As usually found it is slightly magnetic, in consequence of the inclusion of impurities. It dissolves easily in HCl, and by H_2SO_4 it is changed to a white mass consisting principally of $PbSO_4$.

Fe_2O_3	FeO	MnO	PbO	CaO	MgO	$CaCO_3$
55.58	9.83	2.00	21.29	1.55	1.80	7.95

which corrected for the $CaCO_3$ becomes

Fe_2O_3	FeO	MnO	CaO	MgO	PbO
60.38	10.68	2.20	1.67	1.95	23.12

corresponding to (PbO FeO MnO) Fe_2O_3.——*Ferro-goslarite* is a zinc sulphate from Webb City, Jasper Co., Mo., of the composition $ZnSO_4 = 55.2$; $FeSO_4 = 4.9$; $H_2O = 39.00$; Impur = .8. According to Wheeler[1] it occurs as incrustations on the walls of a large body of zinc-blende, with which is associated marcasite and galena. Its formation is due to the oxidation of the zinc and iron sulphides and their subsequent crystallization from solution. It is slightly yellow to brown in color, and is brittle. Its hardness is 2.5, and it loses water on exposure to the air, turning to an opaque, yellow powder in the process. ——*Rowlandite.*—Associated with gadolinite and other yttrium minerals in Llano Co., Texas, Hidden[2] has found a pale drab-green substance that is transparent in thin splinters, and has a density of 4.515. It is easily soluble in acids, leaving a gelatinous residue. Upon alteration it yields a waxy, brick-red product. A partial analysis showed the presence of $SiO_2 = 25.98$; Y_2O_3 etc. $= 61.91$; $FeO = 4.69$; $UO_3 = .40$; $CaO = .19$; Loss = 2.01, indicating the formula $R_4'''(SiO_4)_3$.—*Offrétite*[3] is a new zeolite from the basalt of Mt. Simiouse, near Montbrison, in France. It occurs in very small, colorless, hexagonal crystals, with only the base and prism well developed. Their cleavage is basal. Density = 2.13 and composition:

SiO_2	Al_2O_3	CaO	K_2O	H_2O	
52.47	19.06	2.43	7.72	18.90	$= (K_2Ca)_2\,Al\,Si_{14} + 17\,H_2O.$

——*Morinite*[4] is a rose-colored mineral with a difficult cleavage par-

[1] *Amer. Jour. Sci.*, March, 1891, p. 212.

[2] *Amer. Jour. Sci.*, Nov., 1891, p. 430.

[3] Gonnard, Bull. Soc. France. d. Min. xiv. p. 58.

[4] Lacroix, Ib., xiv, p. 187.

allel to the triclinic $\infty P\breve{\infty}$. It is associated with amblygonite at Montebras, Creuse, France. Its crystals contain the three pinacoids, the prisms and several domes. The plane of their optical axis is parallel to $\infty P\bar{\infty}$, and the extinction in this face is 30°. The optical angle is variable, but it never exceeds 40°. The specific gravity is 2.94, and the mineral contains alumina, soda, phosphoric acid, fluorine and water. With it is associated another hydrated phosphate, crystallizing in pyramids.——*Darapskite, lauterite, iodchromate.*—Dietze[1] describes several new minerals from the Pampas Lantaro in Chile. The first mentioned is a double salt of sodium nitrate and sulphate, of the formula $Na\,NO_3 + Na_2\,SO_4 + H_2O$. It contains $SO_3 = 32.88$; $N_2O_5 = 22.26$; $Na_2O = 38.27$; $H_2O = 7.30$. The mineral is clear and colorless, and is in quadratic tables. Lauterite is particularly interesting as being the first iodate known to occur in nature. Its composition [$I = 64.70$; $CaO = 14.95$] corresponds to $Ca(IO_3)_2$. It occurs in well-developed, large prisms, apparently monoclinic, imbedded in gypsum or implanted in the rocks underlying the pampa. It is transparent and of a yellowish color. Its density is 4.59, and it dissolves quite readily in water. Iodchromate is a peculiar compound in that it is a double salt of the iodate and chromate of calcium, of the formula $7\,Ca(IO_3)_2 + 8\,Ca\,CrO_4$. One analysis gave $I_2O_5 = 58.12$; $CrO_3 = 19.00$; $CaO = 22.01$. The crystals are badly developed. They are of a deep yellow color, and they dissolve easily in water.——*Paramelaconite* and *Footeite.*—Dr. Foote recently obtained from Bisby, Arizona, several specimens affording two new minerals that have been examined by Koenig.[2] One is in bronzy, pyramidal crystals, set in a mass of indigo blue needles, implanted on a mammillary substance composed of a mixture of cuprite and limonite. The dark crystals, named *paramelaconite,* are tetragonal, with a pyramidal habit resembling that of Brazilian anatase, and an axial ratio $a : c = 1 : 1.6643$. The hardness of the new mineral is the same as that of apatite. Its streak is black, and its analysis yielded: $CuO = 87.66$; $Cu_2O = 11.70$; $Fe_2O_3 = .64$. Since the CuO is in such large quantity and since it was found to include little particles of cuprite, the author concludes that the mineral is a dimorph of melaconite. The indigo blue needles are monoclinic combinations of $\infty P\breve{\infty}$, $\infty P \times P$, $P\breve{\infty}$ and $P\bar{\infty}$, with an hexagonal habit. Many of the crystals are twins, like those of harmotome. Their composition

[1] *Zeits. f. Kryst,* xix, 1891, p. 447.

[2] *Zeits. f. Kryst,* xix, p. 595.

($CuO = 63.7$; $Cu\,Cl_2 = 13.5$; $H_2O = 22.8$) leads to the formula $8[Cu(HO)_2]CuCl_2 + 4H_2O$. The name chosen for them is Footeite, after their discoverer.——*Rumpfite.*—On the clefts of pinolite, from Jassing, in Obersteiermark, Germany, Firtsch[1] found associated with talc a flaky, greenish-white, translucent mineral with a hardness of 1.5 and a density of 2.675. Under the microscope it appears to be uniaxial and hexagonal. Its composition is:

SiO_2	Al_2O_3	FeO	CaO	MgO	H_2O	Total
30.75	41.66	1.61	.89	12.09	13.12	= 100.12,

corresponding to $H_{28}\,Mg_7\,Al_{16}\,Si_{10}O_{65}$. It deports itself like a chlorite.——*Bolleite.*—Mallard and Cumenge[2] have found among the copper series of Boleo, near Santa Rosalie, in Lower California, a large quantity of a blue copper mineral that often crystallizes in cubes and octohedrons. It is associated with auglesite, cerussite, atacamite and gypsum. An analysis of the cubical forms gave:

Ag	Cu	Pb	Cl	Aq	O(by diff.)
8.80	14.22	49.10	19.48	4.38	4.02,

corresponding to $Pb\,Cl_2 + CuO\,H_2O + \frac{1}{3}\,Ag\,Cl$ or $3[Pb\,Cl(HO).\,Cu\,Cl(HO)] + Ag\,Cl$. The hardness of the crystals is but little superior to that of calcite. Their density = 5.08 and their index of rafraction is about 2.07. Sometimes the cubes are modified by the dodecahedron, but the dodecahedral faces have not their usual positions, that one most steeply inclined to each axis occurring nearer the termination of that axis than the one less steeply inclined thereto, so that the edges of the cube are replaced by pairs of two faces making re-entering angles with each other. The optical properties of thin sections of these crystals indicate that they are tetragonal, negative forms that unite to give rise to a pseudo-regular one. The octahedral crystals are in reality tetragonal pyramids with $a : c = 1 : .9873$. Boleite differs from percylite in containing silver.——Sjögren[3] describes three new minerals from Sweden. The first, *astochite*, occurs as a coarse, columnar aggregate of a blue or grayish violet color at Langban. Its cleavage is that of hornblende. Its density varies

[1]Sitzb. Wien, Ak. 99, 1890, p. 1. Ref. Neues. Jahrb. f. Min., etc., 1892, I, p. 31.

[2]Bull. de la Soc. Franc. d. Min. xiv. p. 283.

[3]Geol. Fören. i. Stock. Förh. xiii, 1891, pp. 605 and 781.

between 3.05–3.10, and its extinction between 15°40′ and 17°15′. The analysis of the blue variety yielded:

SiO_2	FeO	MnO	MgO	CaO	Na_2O	K_2O	H_2O	F	= Total
56.25	.15	6.49	21.89	5.44	6.17	1.60	1.56	.15	= 99.70

The second, *adelite*, occurs at Laugban and at Nordmark in mass of a gray color, with a hardness of 5 and a density of 3.76. Its analysis leads to the formula $2CaO, 2MgO, H_2O, As_2O_5$. The third, *svabite*, is probably an apatite. It is found in colorless hexagonal prisms at Harstig Mine, Pajsberg. $a : c = 1 : .7143$. Composition = $H_2O. 10CaO. 3As_2O_5$.

BOTANY.

The Sargasso Sea.—In a recent number of Petermann's 'Mitteilungen' Dr. O. Krümmel states the result of his investigations into this interesting marine problem. In the first place, he differs entirely from Humboldt as to the shape of the floating mass of vegetation. The "great bank of Flores and Corvo" is, he says, Humboldt's summing up of the observations made by sailing-vessels passing through the Sargasso Sea on their way from the Southern hemisphere to Europe. These followed with slight variations the same course, and their observations were naturally limited in extent. It was on these insufficient data that Humboldt founded his theories as to the size and shape of the Sargasso Sea, but now, by the aid of steam, we are able to arrive at more correct conclusions on these points. On a map which he has prepared Dr. Krümmel has plotted out the general contour of the mass of floating vegetation, and has indicated in what parts of the sea the sargasso is found in the greatest abundance. In shape the Sargasso Sea is a sort of ellipse, the great axis of which almost coincides with the Tropic of Cancer, while the two foci are near long. 45° and 70° West. Around this central ellipse others are indicated, larger in size, but with the vegetation much less dense. In their general outline they follow with sufficient nearness the course of the prevailing winds. As to the origin of the algæ, Dr. Krümmel is strongly of the opinion that they come from the land—not only from the Gulf of Mexico and the coast of Florida, but from the shores of the Antilles and the Bahamas. The most recent studies with regard to the origin and course of the Gulf Stream tend, he thinks, strongly to support those who assert that the algæ come from the land, and to disprove the contention of those

who support the hypothesis of a marine origin. Now that it is settled that the Gulf Stream is not a single narrow stream issuing from the Gulf of Mexico, but an accumulation of converging currents sweeping past the coasts of the Antilles and through the adjoining seas, it is obvious that the quantity of algæ carried away must be much greater than it could have been were the old hypothesis of the origin of the Gulf Stream correct. Dr. Krümmel makes an opproximate calculation as to the time occupied by the algæ in reaching the Sargasso Sea. A fortnight after reaching the Gulf proper, the weed would, at the rate of two knots an hour, reach the latitude of Cape Hatteras. From that point its onward motion is slower, and it takes about five months and a half for it to reach west of the Azores. After reaching the Sargasso Sea the weed continues to move slowly, until, becoming heavier as it grows older, it gradually sinks to make way for fresh supplies. (Proceeds. Roy. Geog. Soc., Oct., 1891.)

Ferns of the Black Hills.—Last July while collecting in the Black Hills of South Dakota the following ferns were recorded. My collecting field was in the central portion of the Hills in the vicinity of Harney's Peak. About the same time Professor Williams of Brookings, S. D. visited the eastern part of the Hills, and made a few notes which I add to mine. This list is interesting inasmuch as it is much larger than any yet made for this region, including several species not hitherto known to grow this far west.

Polypodium vulgare L.—Abundant on the rocks in and about Harney Glen, on the side of Harney's Peak.

Adiantum pedatum L.—Reported on good authority from near Hot Springs, but no specimens were secured.

Pteris aquilina L.—Specimens were seen, but not collected, between Hill City and Deadwood.

Cheilanthes lanuginosa Nutt.—On the rocks at Custer; Professor Williams collected it at Rapid City, also.

Pellæa atropurpurea Link.—On the rocks at Custer. Collected at Rapid City also by Professor Williams.

Asplenium trichomanes L.—On the rocks at Custer, and in the ravines on Harney's Peak.

Asplenium septentrionale Hoffm.—In the crevices of rocks at Custer, and in Harney Glen. This is a most curious fern, resembling a tuft of grass.

Asplenium filix-fœmina Bernh.—On moist soil at Custer.

Phegopteris dryopteris Fee.—In a bog in Harney Glen.

Aspidium filix-mas Swartz.—In moist places in Harney Glen.

Aspidium filix-mas Swartz, var. *incisum* Nutt.—What I take to be this variety was collected in Harney Glen. It differs from the preceding in having more incised pinnules, and in being freer from chaff on the rhachis.

Cystopteris fragilis Bernh.—In shaded places near rocks at Custer. The specimens collected were covered with a fine rust, *Uredo polypodii* (P.) D. C.—This fern was collected at Rapid City, also by Professor Williams.

Onoclea sensibilis L.—In shaded thickets on the sides of Buckhorn Mountain, and in ravines approaching Harney's Peak.

Onoclea struthiopteris Hoffm.—In cañon of Rapid Creek near Rapid City (Professor Williams).

Woodsia oregana D. C. Eaton.—Collected at Rapid City by Professor Williams.

Woodsia scopulina D. C. Eaton.—Common in the crevices of rocks at Custer.

Botrychium virginicum Swartz.—Collected at Rapid City by Professor Williams, who reports it to be rare.—CHARLES E. BESSEY.

Notes on the Flora of Western South Dakota.—(*Concluded from* p. 63.)—The time spent in the Black Hills region was too short to enable one to form any very accurate ideas regarding its large and varied flora. There is a mixture of Rocky Mountain forms with those of the astern flora, which with the prairie forms make the Black Hills flora ae very interesting one. The cañons are pleasing fields to the student. Working up one cañon we find in a shady nook *Lophanthus anisatus*; on the drier flats are many kinds of *Eupatorium* and *Aster*, and an abundance of *Argemone platyceras*, while on several shady banks *Onoclea struthiopteris* grows as tall as a man's head. Up a small side cañon are found *Potentilla fruticosa*, *Physocarpus monogynia*, *Arctostaphylos uva-ursi*, *Disporum trachycarpa*, and *Shepherdia canadensis*. Out into another and darker side cañon, and we see *Pyrola secunda*, *P. chlorantha*, *Maianthemum canadense*, *Pterospora andromeda*, along the dry bottom of another *Mentzelia oligosperma*, *Geranium richardsonii*, *G. carolinianum* and *G. dissectum* were collected. Far up a narrow, dark gorge grows *Mimulus luteus* with *Corylus rostrata* on the bank above. Along the higher bluffs, *Pinus ponderosa* var. *scopul-*

orum makes the greater part of the timber, but lower down in the cañons are *Betula papyrifera, B. occidentalis, Ostrya virginica,* both the junipers, *Fraxinus viridis, F. pubescens, Populus monilifera, P. tremuloides, Ulmus americana,* and *Quercus macrocarpa.* This last has a number of very interesting and perplexing forms. *Ribes gracile, R. aureum, R. floridum* are very plentiful, and when we were there were loaded with fruit, all of which was quite palatable excepting that of *R. cereum*; cherries were also plentiful. *Rubus strigosus* was abundant in many places, and was loaded with fruit, which was ripe in August.

There are a great many introduced plants in the larger valleys, and a discussion of their introduction would be interesting were one better acquainted with them and their surroundings.

Quite a number of fungi were found here. Of the lichens I shall say nothing now except that the lichen flora is very interesting, and that I found many good things.

When we left the Black Hills for the Bad Land region we followed down a stream called Spring Creek. We had been told that there was considerable timber on the stream. Most of the way down, the wagon road is at the foot of the bluffs at some distance from the stream, and no trees could be seen. We concluded that we had been misinformed. By-and-by we turned to cross the stream and found that there was a second bottom between us and the stream, and that the real valley was hidden from our sight. This was covered with a fine growth of elm, ash, hackberry, boxelder, willow, etc. There is wood enough along this one stream to keep a whole county in wood if rightly used.

The Cheyenne Valley, at the mouths of Spring Creek and Indian Creek, differs but little from that in the vicinity of Smithville before mentioned.

By following up the Indian Creek Valley one can enter the Bad Lands proper in the vicinity of Sheep Mountain. This flora is also interesting. All the plants, excepting a few stunted introduced species are of the kinds adapted to a dry climate and poor soil. The chenopods are well represented by *Atriplex nuttallii, A. argentea, A. patula,* var. *hastata, Sarcobatus vermiculatus* and several species of *Chenopodium. Atriplex nuttallii* and *Sarcobatus vermiculatus* are most plentiful on the sterile sides of the buttes and hills, both becoming quite shrubby with age. The old stems are often well covered with several species of lichens. Along the sides of Sheep Mountain and some other of the more favored places *Juniperus virginiana* is quite

abundant. The valleys bordering the streams are sometimes quite well sodded with grass, but no species of much importance are found except in the larger valleys or in the basins. *Andropogon scoparius* is the commonest of these grasses. It is of no use at all as a forage grass, since stock will not eat it either green or as hay, and but few machines can be found that will cut it. In some of the larger basins *Boutelua racemosa*, several species of *Calamagrostis*, *Spartina cynosuroides* and *S. gracilis* and *Panicum virgatum* are the principal forage plants.

The timber of the Bad Land streams consists chiefly of *Populus monilifera*, *Shepherdia argentea* and an occasional elm, box-elder or ash. *Physaria didymocarpa* is very common throughout the whole region, its thick, fleshy leaves reminding one of the large-leaved Sedums.

Astragulus is represented by *A. bisulcatus*, *A. sericoleucus*, *A. gracilis*, *A. missouriensis* and *A. caespitosus*. *Sophora sericea*, abundant all along the Cheyenne, gets up into the woodlands in many places. The Cacti are represented by *Opuntia rafinesquei*, *O. fragilis*, and *O. missuriensis*, in many puzzling forms, *Mamillaria vivipara* and *M. missuriensis*. All these are plentiful, *O. fragilis* and *O. rafinisquei* apparently preferring the higher table-lands and the others the basins and lower table-lands. *Rhus radicans* and *R. canadensis* var. *trilobata* occur in many places.

Almost in the centre of the Great Basin there is a veritable oasis. At the base of a long hill of considerable height there is a cluster of springs known as Iron Springs, from the peculiar taste of the water. The entire hill seems to be made of better soil than the surrounding country, for it is covered with a fine growth of grass, including many of the best species, as *Boutelua racemosa*, *Andropogon furcatus*, *A. nutans*, *A. hallii* and *Panicum virgatum*. Here we also found *Eurotia lanata*, *Psoralea cuspidata*, *P. lanceolata*. *P. argophylla*, *P. digitata* and *P. tenuiflora*, *Aster multiflorus*, *Artemisia ludoviciana*, *A. longifolia*, *A. filifolia*, *Agropyrum glaucum*, *A. tenerum* and many other prairie species. Along the more abrupt sides of the hill grew *Celtis occidentalis*, *Juniperus virginiana*, *Populus balsamifera*, *P. monilifera*, *Ulmus americana*, *Prunus virginiana*, *P. americana*, *Acer negundo*, *Fraxinus viridis* and *F. pubescens*. In the immediate vicinity of the springs a great many plants were found that one would hardly expect. Some of the finest plums, either wild or cultivated, that I have ever eaten grew on bushes fringing the springs. Here also were elm, ash, blackberry, cherry, box-elder, willow, *Ampelopsis quinquefolia*, *Ribes aureum*, *R. floridum*, *R. gracile*, *Parietaria pennsylvanica*, *Symphoricarpus occi-*

dentalis, Polygonum dumetorum var. *scandens, Phryma leptostachya, Distichlis maritima, Lemna minor, L. polyrrhiza, Mimulus jamesii, Spartina cynosuroides* and *gracilis,* with other species common to prairie and timbered regions. Many of the species found at these springs were found no nearer than the Black Hills or the Missouri River, yet here they seemed to flourish in the very centre of the great Bad Land region.

I append a list of a few of the more characteristic species of each of the three regions.

The Range. — *Stipa comata, Boutelua hirsuta, Boutelua oligostachya* and *B. racemosa, Agropyrum glaucum, A. repens, Yucca angustifolia, Sophora sericea, Shrankia uncinata, Psoralea argophylla, tenuiflora, cuspidata* and *esculenta, Astragalus caryocarpus* and *flexuosus; Gutierrezia euthamiæ, Solidago missouriensis, canadensis* and *serotina; Helianthus petiolaris, Marsilia vestita.*

The Black Hills.—*Onoclea struthiopteris, Juniperus communis* and *virginiana; Picea alba, Pinus ponderosa* var. *scopulorum, Betula occidentalis* and *papyrifera; Erigeron salsuginosus, Ostrya virginica, Corylus rostrata* and *americana; Pyrola chlorantha* and *secunda; Pterospora andromeda, Androsace septentrionalis, Hedeoma drummondii, Lophanthus anisotus, Mimulus luteus* and *ringens; Shepherdia canadensis, Euphorbia dictyosperma, Sambucus canadensis* and *racemosa; Aralia nudicaulis, Actæa rubra* and *alba; Disporum trachycarpum, Geranium richardsonii, carolinianum* and *dissectum; Mentzelia oligosperma, Quercus macrocarpa.*

The Bad Lands.—*Spartina gracilis, Sporobolus airoides, Sporobolus asperifolius, Andropogon hallii, Physaria didymocarpa, Astragalus sericoleucus, Astragalus caespitosus, Astragalus gracilis, Astragalus pictus, Œnothera caespitosa, Sarcobatus vermiculatus, Atriplex nuttallii, Parmelia molliuscula, Urceolaria scruposa* var. *gypsacea, Ulceolaria scruposa,* var. *parasitica, Tylostoma mammosum, Geaster delicatus.*—

T. A. Willihms.

ZOOLOGY.

Work of Earth-worms in Yoruba Country, West Africa.—In the Proceedings of The Royal Geographical Society, October, 1891, Mr. Alvan Millson gives the following account of the extraordinary work done by West African earth-worms.

"Northward from Ibadan, which may be described as the centre of the chief military and commercial power in Yoruba, two days journey—about forty miles—through many villages, and a landscape dotted far and near with oil-palms (*Elais guineensis*), along a road thronged with travelers, brings one to the capital of central Yoruba, Oyo (Awyaw). On leaving Ibadan I passed in the course of our morning's march over 4700 men, women, and children, hurrying into the great city from the farm villages, with loads of maize, beans, yams, yam flour, sweet potatoes, fowls, pigs, ducks; or driving cattle, sheep, and goats; or mounted on small native horses which amble quickly along under the combined influence of an Arab ring-bit and an armed spur which leaves its traces in deep scores along the flanks of the poor animals.

"Far and wide the land has, for generations, and indeed for centuries, been cultivated by these industrious natives. The hatchet, the fire, and the hoe have removed all traces of the original forest, save indeed where a dark trail of green across the landscape shows where the valley of some narrow watercourse or larger river is hidden among trees.

"For two or three years at most the land is allowed to lie fallow, while for three or four years double or treble crops are raised with no further cultivation than an occasional scrape with a hoe, and during its fallow time no further care is taken of it than to let a rank growth of reedy grass spring up some six or eight feet in height. Among this grass can be seen the seedlings and young plants of a new forest which would rapidly take possession were the land to be permanently deserted.

"In spite of this careless and exhausting method of cultivation the crops maintain an excellent average, and the same plot of ground serves for generations to support its owners.

"The following extracts taken from notes taken at the time will serve to explain the apparently inexhaustible fertility of a soil which does not at first sight show any signs of unusual richness.

"Were one to visit Yoruba during the early part of the rainy season only, it would appear impossible to account for these facts..... while under our feet unnoticed was going on the ceaseless labor of the real fertilizers of the land.

"In the dry season the mystery is at once solved, and in the simplest and most unexpected manner. The whole surface of the ground among the grass is seen to be covered by serried ranks of cylindrical worm casts. These worm casts vary in height from a quarter of an inch to three inches, and exist in astonishing numbers. It is in many places impossible to press your finger upon the ground without touching one. For scores of square miles they crowd the land, closely packed, upright, and burned by the sun into rigid rolls of hardened clay. There they stand until the rains break them down into a fine powder, rich in plant food, and lending itself easily to the hoe of the farmer. Having carefully removed the worm casts of one season from two separate square feet of land at a considerable distance from one another, and chosen at random, I find the result to weigh not less than ten and three-quarters pounds in a thoroughly dry state. This gives a mean of over five pounds per square foot. Accepting this as the amount of earth brought to the surface every year by these worms, we get somewhat startling results. I may say, speaking from the result of numerous experiments, that five pounds is a very moderate yearly estimate of the work done by these busy laborers on each square foot of soil. Even at this moderate estimate, however, of the annual result of their work, we have a total of not less than 62,233 tons of subsoil brought to the surface on each square mile of cultivatable land in the Yoruba country year after year, and to the untiring labors of its earth-worms this part of West Africa owes the livelihood of its people. Where the worms do not work, the Yoruba knows that it is useless to make his farm.

"Estimating one square yard of dry earth by two feet deep as weighing half a ton, we have an annual movement of earth per square yard to the depth of two feet, amounting to not less than forty-five pounds. From this it appears that every particle of earth in each ton of soil to the depth of two feet is brought to the surface once in twenty-seven years.

"The earth-worm which produces such surprising results has been identified as a new species of *Siphonogaster*, a genus known hitherto only in the Nile Valley."

The Worm Gymnorhynchus Reptans.—M. Moniez has recently found a perfect specimen of *Gymnorhynchus reptans* in *Oxyrhina glauca.* This genus is distinguished from other species of Tetrarhynchides, known in the larval state, by a curious appendage at the end of the sac into which the animal can retract the anterior part of its body as in a cyst. This appendage, about one meter in length, forms a net-work in the tissues of its host, and it is extremely difficult to get the entire animal. Contrary to what has been supposed by Van Beneden, the sac into which the anterior part of the larvæ is retracted, as well as the enormous appendage do not persist in the adult animal, nor are they sexed; it is digested by the new host, and of this very long animal there remains only the neck and that small portion of the tissues attached to which the name "zone génératrice" has been given and upon which depends the formation of the chain of rings which complete the animal.

M. Moniez considers this peculiar appendage comparable with that found in several Cestodes of the type of *Tænia serrata.* (Revue Biol. Jan. 1892).

New Fishes from Chihuahua, Mexico.—During the months of July and August, 1891, some collections of fishes were made by the author at several points in Mexico, from Orizaba to Chihuahua; many interesting specimens were taken, several of which are believed to be new to science. The specimens here described were taken from the Rio de las Conchos at Chihuahua. The river bed here is half a mile wide in places, with numerous sand bars and depressions. It is little more than a river bed however, owing to the almost total lack of rainfall throughout the entire year. The water in this large river bed is reduced to a very diminutive stream that is brought from the mountains ten miles away by an aqueduct to supply the city with water.

A mile below the city the stream is dammed, in order to use the water for irrigating purposes. Here on one side the bank is high and rocky and the water is entirely too deep to be seined. The other bank is composed of sand, sloping gradually to the deeper water, and is easily accessible. The bottom is covered with several inches of mud, and in many places the shallow parts are thickly grown with various water weeds.

These quiet waters swarm with fish, for the most part of the minnow family.

At the upper end of the pond the water was shallow, clear, and in places swift enough to form ripples, here a number of Cyprindontidæ

and two species of darters were taken, making about sixteen species in all.

Notropis chihuahua sp. nov.—Body elongate, back little elevated, rising gradually from snout to front of dorsal; head large; snout blunt; mouth nearly horizontal, slightly oblique; maxillary scarcely reaching to front of eye; eye large, averaging $3\frac{2}{3}$ mm. longer than snout, but not quite equal interorbital space; anterior part of dorsal midway between snout and caudal; scales deeper than long, not crowded anteriorly; lateral line straight, nearly every scale with a pore.

Color, light brown above; edges of scales above the lateral line with small but closely placed black dots; body also above the lateral line thickly but irregularly sprinkled with dark brown spots, these gradually becoming more numerous toward the median line of the back, where they form a vertebral line; the side of the body with a plumbous lateral stripe, of about the width of the eye; this lateral stripe can be traced through the eye and around the snout, thickly sprinkling the upper lip with small dots, but not touching the lower lip; the lateral stripe terminates in an irregular spot at base of and between the lobes of the caudal; sides below the lateral line silvery; belly, plain white. The fins are plain except the dorsal and caudal which are dusky but without distinct markings; teeth 4–4; hooked grinding surfaces very narrow.

Following are measurements of a few specimens in mm., the length being taken from snout to base of caudal fin.

Length.	Head.	Depth.	Eye.	Lat. line.	Dorsal.	Anal.
58	15	15—	4	34	8	7
58	15	15—	4	37		
57	15—	14	4	35		
53	13+	15+	3.5	34		
50	12	13.5	3.5	36		
49	12	13	3.5	33		
54	14	14	4—	33		
53	13+	14	4—	35		
51	13	14	3.5	34		
50	14.5	13	3.5	36		

Etheostoma scovellii sp. nov.—Body stout, head large, snout abruptly decurved, back but little elevated, caudal peduncle broad, spinous dorsal low. Body covered with about ten bands, $1\frac{1}{2}$ mm. wide, of a dark purplish cast, olive between; the first, second and fifth

extending over the back. Pectoral and ventral fins plain, spinous dorsal bordered with black, also an imperfect stripe close to back; soft dorsal with two imperfect dark stripes; caudal frequently barred. Mouth horizontal, lower jaw included, maxillary reaching a little back of front of orbit, nearly to edge of pupil. Lateral line incomplete, reaching to about midway of the soft dorsal.

Measurements taken as in specimens described above.

Length. (total)	Head.	Depth.	Lat. line scales.	Dorsal rays.	Anal rays.
33	10	7	64	XII– 9	I–8
33	10	8	64	XII–11	I–8
33	10	7	64	XII–10	I–8
33	10	7	58	XII–11	I–8
33	10	6+	63		
33	10	6	60		
33	10	6+	63		
30	10—	5.5	64		
29	10—	6	62		
30	10	5	63		

—A. J. Woolman, South Bend, Indiana. March, 1892.

Description of a New Mouse from Southern California.—Seventeen specimens of a long-tailed Vesperimus collected at Dulzura, San Diego Co., Cal., belong to a species very different from any hitherto described. In size and general characters they agree closely with *V. eremicus*, but the color is curiously like that of *V. californicus*. The species may be known by the following characters:

Vesperimus fraterculus sp. nov. Size medium, tail decidedly longer than head and body, thinly-haired and without pencil; soles naked; ears rather large and very thinly-haired except at base and along anterior margin.

Adult male and female (♀ No. $\frac{1135}{962}$ collection of G. S. Miller, Jr., Dulzura, San Diego Co., Cal., January 7, 1892. Charles H. Marsh, collection ♂ No. $\frac{1217}{1044}$ same locality and collector, January 15, 1892); fur everywhere, except in region of mouth, slaty plumbeous at base; ventral surface dirty yellowish-white, becoming purer on throat and chin; a distinct fulvous pectoral spot; sides with a clear fulvous stripe extending from region of eyes to base of tail, under which the stripes of the two sides meet; this fulvous area almost entirely without black-tipped hairs and sharply defined against the color of the

belly, but shading insensibly into that of the back; dorsally yellowish wood-brown, becoming grayish between the ears and over the head and muzzle, everywhere much intermixed with black-tipped hairs, which produce a decided blackish shade throughout the region from shoulders to base of tail and well down over the sides; a narrow dusky ring around eye; tail brownish, slightly paler ventrally, without distinct line of demarkation; whiskers reaching about to shoulders, mixed dark-brown and silvery gray; dorsum of manus and pes white; color of sides extending about to wrists and ankles, which latter are dusky in front.

Measurements taken from the fresh specimens by the collector:

No.	Sex.	Date.	Length.	Tail vertebræ.	Hind foot.	Ear from notch.
1217/1044	♂	Jan. 15, '92	185	113	20	18[1]
1093/924	♂	Nov. 23, '91	185	102	20	16
1096/927	♂	Nov. 28, '91	167	90	20	16
1097/928	♂	Dec. 1, '91	200	118	22	18
1099/930	♂	Dec. 10, '91	170	90	18	15
1132/956	♂	Dec. 26, '91	173	100	20	16
1133/960	♂	Jan. 6, '92	150	78	20	15
1134/961	♂	Jan. 7, '92	180	103	20	18
1136/963	♂	Jan. 8, '92	182	102	20	15
1095/926	♀	Nov. 21, '91	188	105	20	16
1098/929	♀	Dec. 8, '91	200	113	22	16
1135/962	♀	Jan. 7, '92	192	110	20	15[1]
1137/964	♀	Jan. 12, '92	185	105	20	—

It will be seen that *Vesperimus fraterculus* agrees very closely in size with *V. eremicus*.[2] The very much darker color of the former will, however, serve to distinguish the two species at a glance.

The series show but little individual variation in color. The coloring of the dorsal surface is remarkably constant, the variation among the adults being practically confined to the amount of shading produced by the black-tipped hairs. They are tolerably evenly distributed and do not tend to form a dark dorsal streak. Three specimens younger than the rest are grayer, but have the fulvous lateral stripe nearly as well developed as the adults. The dirty yellowish white

[1]Type.

[2] See table of measurements given by Dr. C. Hart Merriam, North American Fauna, No. 3, 63.

tinge on the belly is more pronounced in some specimens than in others, and in most there is a tendency for the fur in the region of the anus and genital organs to become pure white. The fulvous pectoral spot is absent in two specimens, and in the others varies from a mere trace to an irregular stripe 25 mm. long and about one third as broad in the widest part. The dusky mark at the ankle is conspicuous in some individuals and nearly absent in others.

The skull of *Vesperimus fraterculus* resembles so closely that of *V. eremicus* that I can find no character by which to distinguish them. The number of specimens of *eremicus* at my disposal is, however, too limited to furnish satisfactory data. As compared with skulls of *V. americanus*, those of *V. fraterculus* average shorter, with brain case of about equal width and rather flatter. The nasals end in an obtuse angle about 1 mm. short of the premaxillaries. They are narrower than in *americanus*. The incisive foramina extend about to first third of anterior molar. The articular process of the mandible is shorter, and the coronoid occupies a more posterior position. The posterior upper molar is relatively smaller than in *americanus*. The following are some cranial measurements of seven specimens of *V. fraterculus*.

Number	$\frac{927}{1096}$	$\frac{930}{1099}$	$\frac{959}{1132}$	$\frac{960}{1133}$	$\frac{929}{1098}$	$\frac{962}{1135}$	$\frac{964}{1137}$
Sex	♂	♂	♂	♂	♀	♀	♀
Basilar length	21.4	19	19.8	19	21	20.6	20.8
Basilar length of Hensel	19	17	17.6	16.4	18.8	18	18.4
Zygomatic breadth	12.6	12	11.8	11.4	—	12	12.6
Interorbital constriction	4	4	4	3.8	4	3.8	3.6
Greatest length of nasals	9.6	8.6	8.4	8.2	9	8.6	8.4
Incisor to molar (alveolæ)	6	5.2	5.4	5.4	6	5.8	6
Incisor to postpalatal notch	10.2	8.2	8.8	9	9.2	9.8	9.2
Height of crown from inferior lip of foramen magnum	7.6	7	7	7	7	6.8	7.4
Length of upper molar series along crowns	3.8	3.8	3.6	3.6	3.4	3.6	3.6
Length of mandible, exclusive of incisors	13.2	11.5	12.6	12.4	13	13	13.2
Length of lower molar series along crowns	4	3.8	3.8	3.8	3.8	3.8	3.6

—Gerrit S. Miller, Jr., Cambridge, Mass. February, 1892.

Zoological News.—A list of a single day's dredging at Port Jackson, N. S. Wales, shows 106 mollusca and sixty-one general invertebrata exclusive of mollusca. Among the crustacea was that rare and interesting species, *Dromia sculpta* Haswell. The specimens obtained enabled Mr. Thomas Whitelegge to settle the question regarding the identity of *Cryptodromia nodulifera* Henderson, described in vol. xxvii. of the Challenger Report with *Dromia sculpta* Haswell. He sees no valid reason why they should be regarded as distinct. (Records Aust. Mus, vol. i., No. 4.) —The Entomostracans recently collected in Russia and Siberia by M. Charles Rabot include nineteen species of Copepods and twenty-seven Cladocera. Although none of them are new to science they are of interest since they are the first reported from that region; and also they afford another proof of the wide geographical distribution of European species. (Bull. Soc. Zool. 1891.) —A new species of Tortricidæ, *Palæobia longistriata*, from N. S. Wales has been described by J. H. Durrant. This species agrees in nervation and structure with the typical forms, but can hardly be said to have the apex of the forewings produced. (Proceeds. Linn. Soc., N. S. W., vol. vi.)

EMBRYOLOGY.[1]

Anatomy of a Human Embryo.[2]—Dr. F. Mall has made a very complete study of the anatomy of an embryo of 7 mm. having about 27 somites and an age closely determined as twenty-six days.

The embryo was cut into 351 transverse sections and every other one of these drawn upon wax plates 2 mm. thick. The wax sections were kept in normal relative position in a plaster mould while the various internal organs were gradually dissected out.

In this way a complete model of the internal organs, as solid bodies seen by removing the overlying tissues from one side of the body, was obtained and subsequently reproduced in a colored lithograph.

A most striking and instructive demonstration of the anatomy of the embryo at this early period is thus represented in Plate 30. The brain and medullary tube, spinal ganglia and auditory vesicle, digestive tract with its branchial pouches, bronchi, pancreas, liver and cloaca together with the Wolffian bodies and ducts, the venous and the arterial parts of the heart and vascular trunks are all represented as solid objects seen in perspective and in a distinguishing color for each system.

The body cavity was studied separately from permanent metal casts made by first casting the hollowed out space in the wax model with Wood's metal, then making a plaster cast of this and finally filling the plaster cast with solder. In this way is shown the origin of the lesser peritoneal cavity as a right diverticulum, near the stomach, communicating with the main cœlom by a constriction that remains as the foramen of Winslow. This becomes of considerable interest from the comparative study made by the author in a preceding number of the same journal, for it is there shown that the single right diverticulum of higher mammals is found in some lower ones and the chick, along with a left diverticulum that early disappears. In some reptiles again both right and left diverticula remain in the adult though even here the right is larger. The ichthyopsida appear to have neither of those diverticula.

Thyreoglossal Tract and the Hyoid.[3]—From the study of sections of a human embryo of 16 mm. Prof. His is led to bring his

[1]This department is edited by Prof. E. A. Andrews, Johns Hopkins University.

[2]Journal of Morphology, 1891, 17 pps. 2 Pls.

[3]Archiv. f. Anat. Phys. 1891, 6 pls.

views regarding the connection of the median *anlage* of the thyroid with the cæcal foramen of the tongue into harmony with the anatomical facts revealed by A. Streckeisen. In this embryo the hyoid comes into intimate contact with the epithelial connection of cæcal foramen and median thyroid and is thus well placed for the formation of those inclusions of gland-tubes within the hyoid described by Streckeisen. Incidentally the study of another embryo of 9·1 mm. leads the author to infer that this median *anlage* may aid in the formation of the lateral thyroids.

Origin of Spinal Ganglia in Man.[1]—Study of a human embryo of 2·5 mm. leads Dr. M. V. Lenhossék to the following conclusions: The medullary plate is at first a median thickening of ectoblast with no thin central region to give it a bilateral or double character. The material for the formation of spinal ganglia first appears as a strand of rounded ectoblast cells, not segmented, along each side of the medullary plate. As the medullary plate closes these two strands unite to form a wedge-shaped mass appearing as cross section as the keystone of the closed medullary tube. Though thus closely united with the tube these spinal ganglian cells grow out again and allow the tube to close a second time without their aid. In this outgrowth the first segmentation appears, the outgrowth being greater in the mesoblastic somite regions, hence the spinal ganglia are from this first appearance intervertebral in position. Later stages are not given, but with the aid of sections of chick and of Siredon the author extends the above view to all vertebrates, explaining away the difficulties offered by certain observations of others; harmonizing the ideas of His and Balfour and in general results agreeing with Beard.

Somites of Human Embryos.[2]—From the embryo mentioned in the last notice and three others of 4·25, 4·5 and 10·2 mm. and with the aid of a comparative study of some lower vertebrates, J. Köllmann obtains facts and explanations of facts that form an interesting contribution to the subject of metamerism in higher vertebrates, though the evidence presented is not all of as convincing a character as might be desired. The chief points may be briefly outlined as follows:

The myotomes (protovertebræ) have at first a cavity, myocœl, which is subsequently filled by an ingrowth of the inner wall. The

[1] Archiv. f. Anat. Phys., 1891, 24 pps. 1 Pl.

[2] Archiv. f. Anat. Phys., 1891, 44 pps., 2 Pls.

inner wall splits open and the ingrowth of cells passes out and ventral to the medulla as the sclerotome or *anlage* of the vertebra. The split becomes the intervertebral cleft or foramen. As the myotome gives rise directly to the sclerotome there is no secondary segmentation of the vertebral column, but rather a proximal dislocation of each sclerotome by the length of half a myotome. After this skeletegenous material has left the myotome its walls give rise to muscles; the inner wall first, forming the dorsal part of the lateral musculature; the outer wall, in man, growing ventrally to furnish muscles for the ventral body wall, digestive tract and also the limbs. The muscles in the limbs are formed from several myotomes, are representations of several metameres, moreover all the segmentation seen in the ventral region and in the limbs is not formed from the lateral plate, but in the above outgrowth into them of parts of the axial myotomes. These muscle buds growing into the limb surround the axial *anlage* of the future skeleton.

Sections of the embryo of 2·5 mm. with 13 somites, show a marked modification of the ectoblast near the intermediate cell mass, becoming a cellular ingrowth posteriorly in older embryos. This is regarded by the author as undoubtedly an ectodermal component of the Wolffian duct.

ENTOMOLOGY.[1]

Descriptions of New North American Bees.—The following species of *Halictus* have the head and thorax and sometimes the abdomen, greenish or bluish, the surface of mesothorax minutely roughened, except in 5, and with a distinct punctuation, the hind spur with few long teeth; and are arranged according to size, beginning with the largest. The following synopsis may aid in separating them:

Mesothorax coarsely reticulated on the sides;
Head greenish, thorax bluish, legs dark, 1. *reticulatus.*
Head and thorax bluish, legs mostly yellow, 2. *hartii.*
Mesothorax punctured, not reticulated;
Head, thorax and abdomen greenish;
Pubescence of abdomen yellowish, thin, not concealing surface, 3. *floridanus.*

[1]Edited by Prof. C. M. Weed, Hanover, N. H.

Pubescence of abdomen white, dense, concealing surface except of 1st and 2d segments, 4. *pruinosus.*
Head greenish, thorax hardly metallic, shining, face very broad between mandibles, 5. *cephalicus.*
Head and thorax greenish, abdomen black or brown, sometimes with a bronzen reflection;
Two submarginal cells, 10. *anomalus.*
Face rounded, clypeus not strongly produced;
Disc of metathorax without enclosure, 6. *obscurus.*
Disc of metathorax bordered by a raised line;
Pale greenish, very sparsely punctured, 9. *apopkensis.*
More bluish, not very sparsely punctured, 8. *illinoensis.*
Face long, clypeus strongly produced;
Wings and nervures dusky, 7. *ashmeadii.*
Wings and nervures whitish, 11. *longiceps.*

1. **Halictus reticulatus.** ♀—Head and thorax bluish, the abdomen black, clothed with thin pale fulvous pubescence; face broad, rounded, clypeus not produced; disc of mesothorax sparsely punctured, on the sides coarsely reticulated; metathorax with a sharp truncation bordered by a salient rim; the disc with a rugose enclosure which is triangular, more or less truncate at edge of declivity, the enclosure bare, elsewhere the metathorax clothed with long, thin pubescence; wings fusco-hyaline, more dusky at tips, nervures and tegulæ testaceous; legs black, knees, anterior and middle tibiæ more or less posterior tibiæ entirely and tarsi testaceous; abdomen shining, impunctate base of second and third segments each with a patch of appressed pale pubescence on the sides. Length 7 mm.

Florida: three ♀ specimens taken at Inverness, Citrus Co., Feb. 12 and 14, on flowers of *Prunus umbellata.*

This species is distinguished from the following by its less coarse sculpturing, its more perfectly defined metathoracic enclosure, paler legs, darker wings, etc. Both are distinguished from all other metallic *Halictus* known to me by their coarsely reticulated mesothorax.

2. **Halictus hartii.** ♀—Black, the head greenish, the thorax bluish, clothed with thin whitish pubescence; face broad, clypeus somewhat produced, punctures dense above antennæ, elsewhere sparse, vertex shining; mesothorax with coarse sparse punctures forming coarse reticulations on the sides; metathorax with abrupt truncation bordered by a sharp rim; the disc very rugous, with enclosure imper-

fectly defined, but appearing triangular, truncate or semicircular; wings fusco-hyaline, second submarginal cell narrow, nervures fuscous, tegulæ black; abdomen shining, impunctate. Length 7 mm.

One ♀ specimen, taken in Southern Illinois, Aug. 11, by Mr. C. A. Hart.

3. **Halictus floridanus.** ♀—Head, thorax and abdomen greenish, the legs blackish; above the pubescence is thin and yellowish, beneath it is white; face long, flat, clypeus strongly produced, mandibles rufo-piceus at tips; disc of mesothorax not shining, minutely roughened, closely and finely punctured; metathorax truncate, the disc covered with fine wrinkles; wings hyaline, nervures and tegulæ testaceous; knees and apical joints of tarsi testaceous; abdomen of same color as thorax, more shining, minutely punctured; clothed with pale pubescence except on discs of first and second segments, the pubescence not concealing the surface, as in the next species; apical margins of segments testaceous, which with the pubescence sometimes gives the abdomen a subfasciate appearance, reminding one of *H. fasciatus* Length 6–7 mm.

Florida: 16 ♀ specimens, taken at Inverness from March 7 to 20, on flowers of *Lupinus villosus* and *Ceanothus microphyllus.* It visits the former for stray pollen, the latter for honey and pollen.

It resembles *H. fasciatus* Nyl. (= *H. flavipes* Thompson) in color and in the sculpture of the disc of metathorax. It is smaller, has a longer, flatter face, the mesothorax more finely roughened and therefore less shining, the abdomen without regular apical fasciæ, etc.

4. **Halictus pruinosus.** ♀—Head, thorax and abdomen green, clothed with a thin hoary pubescence; face long, finely punctured, clypeus strongly produced; mandibles, except base, ferruginous, flagellum testaceous beneath; mesothorax minutely roughened, not shining, closely and rather finely punctured; disc of metathorax with irregular rugæ running from base but hardly reaching apex, which is smooth and somewhat elevated; wings whitish, hyaline, nervures whitish, tegulæ pale testaceous; abdomen shining, almost impunctate, narrow apical margins of segments pale testaceous, all the segments except discs of first and second, densely clothed with hoary pubescence. Length 6 mm.

♂.—Closely resembles the female; clypeus strongly produced, disc of metathorax rougher, abdomen also green, more punctured, shining, with thin pubescence; apex of clypeus, labrum, flagellum beneath,

nervures, tegulæ, knees, tibiæ at tips, and tarsi pale testaceous; one specimen shows the nervures as pale as in female, the other has them much darker. Length 6 mm.

Illinois: 9 ♀, 2 ♂ specimens, taken from May 19 to June 25, on flowers of *Oxalis corniculata*, *Melilotus alba*, *Scutellaria parvula* and *Tradescantia virginica*.

In size, color of pubescence and wings this species closely resembles *H. albipenuis*. It is distinguished from that species by its face, which is longer, a little more sparsely punctured, its mesothorax more closely and finely punctured, its metathorax less rugous, its abdomen green and not depressed.

5. Halictus cephalicus. ♀—Smooth and shining, clothed with very thin pale pubescence, head greenish, thorax blue-black, abdomen brownish; head very large, wider than thorax, strongly produced behind eyes, especially the cheeks below; face subquadrate, finely and sparsely punctured; clypeus transverse, truncate; labrum broad, short, pointed; mandibles long, ferruginous, except base; flagellum testaceous beneath towards tip; prothorax forming a lateral dentiform angle, mesothorax blue-black, shining, sparsely and minutely punctured, appearing impunctate; metathorax black, strongly retracted and strongly sloping, so that it presents a very small truncation, the latter heart-shaped, being divided above by a fissure; wings hyaline, nervures and stigma testaceous; legs blackish, knees, tibiæ at tips and tarsi testaceous; abdomen brownish, impunctate, apical margins of segments testaceous, the segments clothed with thin, pale pubescence. Length 6 mm.

♂.—Resembles the female, but does not show the peculiar head characters, clypeus somewhat produced, metathorax rougher above and bordered on each side by a ridge. Length 5 mm.

Illinois: 1 ♀, 2 ♂ specimens, taken July 15 at a bank which was filled with nests of *H. zephyrus*. The sexes were taken in copula.

This species may be easily distinguished by the shape of its head, which is much like that of the ♀ of *H. ligatus* Say (=*armaticeps* Cress., *texanus* Cress., *ornatipes* Cress., *capitosus* Sm.).

6. Halictus obscurus. ♀—Form rather slender, head and thorax dark blue-green, abdomen black, clothed with thin pale pubescence; face round, the clypeus somewhat produced; mesothorax minutely roughened but shining, sparsely punctured, the pubescence thin; metathorax rather narrow, strongly retracted, truncate, with several

raised lines proceeding from base, but not reaching truncation; wings hyaline, nervures and stigma testaceous; legs black, apical joints of tarsi testaceous; abdomen black, shining, clothed with thin pale pubescence. Length 5–6 mm.

Illinois: 22 ♀ specimens, taken from April 28 to May 12, in woods, on flowers of *Ranunculus septentrionalis, Isophyrum biternatum, Chærophyllum procumbeus, Osmorrhiza longistylis, Polemonium reptans,* and *Ellisia nyctelæa.*

This species closely resembles *H. confusus,* but is distinguished by its more slender form, its darker color, its clypeus more produced, its mesothorax more shining, more sparsely punctured, and more thinly pubescent, its metathorax longer, less rugose, more truncate, its abdomen darker, more thinly pubescent, etc.

7. Halictus ashmeadii. ♀—Head and thorax greenish, the abdomen bronzen, clothed with thin, pale pubescence; face long, the clypeus strongly produced; disc of mesothorax minutely roughened, not shining, densely and finely punctured on the sides; metathorax with a small truncation, the disc finely roughened, more striate laterally; wings subfuscous, nervures dull testaceous, tegulæ testaceous; abdomen rounded, depressed, shining bronzen, clothed with thin pubescence; legs blackish, knees and tarsi testaceous. Length 4–5 mm.

Florida: 12 ♀ specimens, taken from Feb. 12 to March 19, on flowers of *Viola lanceolata, Ceanothus microphyllus, Prunus umbellata* and *Ilysanthes grandiflora.*

This species resembles *H. longiceps* (No. 11), but is distinguished from that species by its larger size, shorter head, more densely punctured mesothorax, darker wings and nervures, etc. Dedicated to the distinguished hymenopterist, Mr. W. H. Ashmead.

8. Halictus illinoensis. ♀—Face broad, rounded, clypeus hardly produced; mesothorax shining, minutely roughened, sparsely punctured, with thin, pale pubescencc; metathorax not strongly retracted, the disc shining, with several longitudinal raised lines; in the middle is a raised line not reaching the truncation; from the tip of this there is a raised line which runs out on either side and forms a superior lateral angle of the truncation, thence it runs forward, joining two or three lines on the extreme side of the disc; wings hyaline, nervures and tegulæ pale testaceous; legs more or less testaceous, especially the knees and tarsi; abdomen shining, brownish, apical margins of segments testaceous, the segments clothed with thin, pale pubescence. Length 5 mm.

Illinois: 2 ♀ specimens, taken Aug. 12, on flowers of *Malva rotundifolia* and *Sium cicutæfolium.*

It closely resembles *H. confusus,* but differs by its smaller size, enclosed metathorax, etc.

9. Halictus apopkensis. ♀—Head and thorax greenish, abdomen brownish; face broad, rounded, finely and rather sparsely punctured, clypeus hardly produced; mesothorax minutely roughened, somewhat shining, minutely and very sparsely punctured, appearing impunctate, with very thin whitish pubescence; metathorax shining, sculptured as in preceding; wings whitish hyaline, nervures and stigma very pale, tegulæ testaceous; knees and tarsi testaceous; abdomen shining, clothed with thin, pale pubescence, apical margins of segments testaceous. Length 5 mm.

Florida: 3 ♀ specimens, taken Feb. 12 and 16, on flowers of *Prunus umbellata* and *Viola lanceolata.* Readily distinguished from the preceding by its paler wings and more sparse punctuation.

10. Halictus anomalus. ♀—Head and thorax dull greenish; face rounded, clypeus produced; disc of mesothorax finely roughened, hardly shining, bare, or nearly so, with sparse, rather coarse, shallow punctures; metathorax shining, not strongly retracted, the disc with elevated lines not reaching apex; wings hyaline, with only two submarginal cells, nervures and tegulæ testaceous; abdomen brownish, shining, impunctate, with thin, pale pubescence. Length 4–5 mm.

Illinois: 2 ♀ specimens, taken May 19, on flowers of *Hypoxis erecta.*

11. Halictus longiceps. ♀—Head as long as thorax, strongly produced behind eyes, clypeus strongly produced, eyes long; mesothorax minutely roughened, hardly shining, finely and sparsely punctured, clothed with thin whitish pubescence; metathorax narrow, disc finely roughened; wings whitish, hyaline, nervures and tegulæ pale testaceous, third submarginal cell subobsolete; abdomen depressed, shining, clothed with pale pubescence. Length 4–5 mm.

Florida: 4 ♀ specimens, taken Feb. 10 to 18, on flowers of *Prunus umbellata.*

Andrena mandibularis. ♂—Black, clothed with long, thin, pale pubescence; head broader than thorax, strongly produced behind eyes; face broad, subquadrate, clypeus flat, shining, thinly pubescent,

with sparse, fine punctures; mandibles long, slender, ferruginous at tip, the extreme base beneath bearing a conspicuous tooth-like spine; mesothorax finely roughened, opaque, impunctate; enclosure of metathorax finely roughened, merely marked by absence of pubescence; wings long, hyaline, nervures honey-yellow, tegulæ dull testaceous; legs slender, black, apical points of tarsi testaceous; abdomen shining, impunctate, with very thin fasciæ. Length 8 mm.

Illinois: 2 ♂ specimens, taken on flowers of *Salix cordata*, April 17.

Calliopsis parvus. ♀—Small, black, opaque, densely and finely punctured, almost destitute of pubescence; mandibles at tips honey-yellow; wings fusco-hyaline, a little dusky at tip, marginal cell obliquely truncate, second submarginal narrowed nearly one-half toward marginal, receiving first recurrent about one-third from base, and the second at or near apex; nervures fuscous, tegulæ testaceous; disc of metathorax with a triangular space bearing fine longitudinal rugæ; abdomen with segments depressed to the middle, the apex with thin, pale pubescence. Length 5 mm.

♂.—Lower corner of face, clypeus, spot on labrum and base of mandibles yellow; flagellum beneath, knees and basal joints of anterior and middle tarsi testaceous. Length 5 mm.

Illinois: 3 ♀, 1 ♂, taken May 28, the female collecting pollen of *Monarda bradburiana*.

Melissodes palustris. ♂—Black, shining, reflecting greenish or purplish, especially on abdomen; head, thorax, and 1st segment of abdomen above with thin, rather pale fulvous pubescence, beneath the pubescence is paler; clypeus yellow, labrum varying from entirely black to entirely pale yellow; antennæ reaching to middle of 2d segment, flagellum fulvous beneath, except the last one or two joints, mandibles sometimes with a yellow spot at tips; disc of mesothorax thinly pubescent, closely punctured, except posteriorly; wings fusco-hyaline, nervures fuscous, tegulæ testaceous; legs black, tibiæ at tips and tarsi ferruginous, claws, except base, black; bases of 2d and 3d and following segments of abdomen densely and finely punctured, opaque, elsewhere shining and sparsely punctured, segments 2–5 each with a broad fascia of appressed white pubescence; that of 2d is basal, only reaching apical margin on each extreme side, that of 3d is on the middle, also reaching apex on each side; the 4th and 5th segments have broad, interrupted apical fasciæ, connected on the mid-

dle of the 4th by an arcuate line, sometimes also similarly connected on 5th, 6th segment with a triangular tooth on each side, 7th with a more slender tooth. Length 12–14 mm.

Illinois: 10 ♂ specimens, taken July 5, 9, and Aug. 5, on flowers of *Dianthera americana* and *Pontederia cordata.*—*Charles Robertson,* Carlinville, Illinois.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Boston Society of Natural History.—February 3d.—The following papers were read: Dr. J. Eliot Wolff, The Geology of the Crazy Mountains, Montana; Mr. Walter G. Chase, The Scenery, Glaciers and Indians of Alaska.

February 17th.—The following paper was read: Prof. George L. Goodale, Illustrations of Vegetation in Ceylon.

March 2d.—The following papers were read: Prof. W. G. Farlow, Notes on collections of Cryptogams from the Higher Mountains of New England; Prof. G. Frederick Wright, Invasion of Eastern England by Norwegian Glaciers; Additional Evidence Concerning Human Remains Under the Sonora Table Mountains, California.

March 16th.—The following paper was read: Dr. J. Walter Fewkes, The Moki Snake Dance.—Samuel Henshaw, *Secretary pro tempore.*

The Biological Society of Washington.—February 20th.—The principal paper of the evening was Factors in the Distribution of Animal Life as Illustrated by Marine Forms, by W. H. Dall. The following communications were read: Mr. F. A. Lucas, On *Charcharodon mortoni*; Mr. J. N. Rose, The Flora of the Galapagos Islands; Mr. John M. Holzinger, On the Identity of *Asclepias stenophylla* Gray, and *Acerates auriculata* Engelm.

March 5th.—The principal paper of the evening was Conditions Affecting the Distribution of Plants in North America, by Fred. V. Coville. The following communications were made: Mr. Charles Hallock, The Physiology of a Pocoson; Mr. Vernon Bailey, The Homes of Our Mammals; Mr. Theo. Holm, The Flora of Nova Zembla.—Frederic A. Lucas, *Secretary.*

The American Physiological Society, which is an offshoot of the Society of Naturalists, held its annual meeting on Dec. 29th at Philadelphia. Some routine business was transacted, and the follow-

ing officers elected for the ensuing year: President, Prof. John G. Curtis, of the College of Physicians and Surgeons, New York city; Secretary, H. Newell Martin, Johns Hopkins University; Council, H. P. Bowditch, Harvard College; R. H. Crittenden, Yale College; W. H. Howell, University of Michigan.

SCIENTIFIC NEWS.

The fourth annual report of the Marine Biological Laboratory at Wood's Holl is issued. From it we glean the following statistics and other items. The laboratory last year accommodated 67 workers, divided as follows: Investigators occupying private rooms, 17; investigators receiving instruction, 9; students, 44. In the report of 1890 a debt of $5,000 was an unpleasant item. This has all been paid, but the laboratory still needs money, not only for an enlargement of the building but for a permanent endowment. In its four years the laboratory has turned out a goodly amount of work, no less than 31 papers being catalogued as issued or in press which are based upon researches carried on at Wood's Holl. The library has been increased by purchase and gift, and 21 periodicals are regularly subscribed for. In his report as director Dr. Whitman indicates the lines for growth. He would have facilities afforded for research in what for want of a better name he calls biological physiology. He would have the laboratory kept open the whole year with a corps of paid investigators, and he would have a more intimate connection between the laboratory and the colleges and universities which patronize it.

The circulars for the coming summer will probably be issued before this is read, but any wishing information about the laboratory can obtain it by addressing either Prof. C. O. Whitman, Clark University, Worcester, Mass., or Prof. H. C. Bumpus, Brown University, Providence, R. I.

Recent Deaths.—Dr. Ernst von Brücke the physiologist, of Vienna, January 7th, 1892, in his 72nd year; he was a pupil of Johannes Müller. Louis Francois Héron-Royer, at Amboise, Dec. 15, 1891, aged 56 years; he was best known for his studies on the life histories of the Batrachia. Prof. Armand de Quatrefages, the well known Zoologist and Anthropologist, in Paris, January 12, 1892, aged 81 years. Prof. Edward Brandt, of St. Petersburg, Dec. 12 (N. S.), 1891; he was best known for his works on the embryology and nervous system of the insects. Sir William Macleay, in Sydney, N. S. W., Dec. 7, 1891, aged 71 years; he was the most prominent person in the development of biology in Australia.

A large treatise on Zoology is announced as in progress. Of publisher, extent, etc. nothing has yet appeared. The list of authors is as

follows: Dr. Fabre-Domergue, Paris: Rhizopoda, Ciliata, Suctoria; Prof. Moniez, Lille: Sporozoa, Trematodes, Cestodes; Prof. Künstler, Bordeaux: Flagellata, Anthozoa; Prof. Vosmaer, Utrecht: Sponges; Prof. Lang, Zürich: Hydrozoa, Siphonophores, Acalephs, Ctenophores, Turbellaria; Prof. E. Van Beneden, Liege: Dicyemida, Tunicates; Prof. Justin, Liege: Orthonectida, Amphioxus, Cyclostomes; M. de Guerne, Paris: Rotifera and Gastrotricha; Prof. Roule, Toulouse, Archiannelida, Sternaspidæ, Phoronis; Prof. de Nabais, Bordeaux: Hirudinei; Prof. Yung, Geneva: Annelida; Prof. Cuénot, Nancy: Bryozoa, Echinoderms; Prof. Joubin, Rennes: Brachipods, Nemertines, Chætognaths; Prof. Pelseneer, Ghent: Molluscs; Prof. Köhler, Lyons, Nemathelminthis, Acanthocephali, Enteropneusti; Prof. Vayssiere, Marseilles: Protracheata, Myriapods, Hexapods; Prof. Barrois, Lille: Arachnida; Prof Giard, Paris: Crustacea; Dr. Dollo, Brussels: Fishes, Batrachia, Reptiles, Birds; Prof. Weber, Amsterdam: Mammals; Dr. Denniker, Paris: Primates.

Dr. Joubin, Palais Universitaire, Rennes, France, wishes to obtain all the brachiopods in alcohol possible, so as to study their anatomy. Exotic specimens are especially desirable.

The "Agassiz Club," with a membership limited by its constitution to fifteen, has recently been started in Corvallis, O.

Regular meetings once a month; extra meetings can be called by vote. It is conducted on much the same principles that characterize the Zoological Club at the Museum of Comparative Zoology, at Cambridge, the rooms being open an hour or two before presentation of regular paper, for perusal of current scientific journals or magazines. The Club, however, is not alone a zoological club. Interesting papers have been read on the following: Electricity, Plant Parasites, The Problem of the Soaring Bird, Some Points in the Anatomy of the Brain.

The President of the Club is Prof. G. W. Shaw; Vice-President, Prof. G. A. Covell; Secretary and Treasurer, Prof. Moses Craig.

The Oriental History Society of Altenburg will celebrate in the Autumn of 1892 the seventy-fifth anniversary of its establishment, and will take advantage of this opportunity to pay tribute to three of the honorary members of the Society by the erection of a simple, worthy monument in the capitol city of Altenburg. They are Chris-

tian Ludwig Brehm, his son, Alfred Brehm, and Prof. Schlegel, who died at Leiden.

The researches of these three men in zoology, and particularly in ornithology, are known, not only among their associates, but throughout the world, and demonstrate that their memory should be honored.

The undersigned committee, under the patronage of His Highness Prince Moritz of Saxe-Altenburg, also an honorary member of the Society, solicits contributions from the friends of these eminent scientists for the purpose of aiding in the erection of the proposed memorial.

It is respectfully requested that contributions be forwarded to Hugo Koehler, Privy-councillor of Commerce, in Altenburg, and that inquiries and letters be addressed to Dr. Koepert, in Altenburg.

The Committee: Prince Moritz of Saxe-Altenburg; Prof. Dr. Blasius, Braunschweig; Dir. Prof. Flemming, Altenburg; Major A. v. Homeyer, Greifswald; Hugo Koehler, Privy-councillor of Commerce, Altenburg; Dr. Koepert, Altenburg; Prof. Dr. Liebe, Privy-councillor, Gera; Prof. Dr. Pilling, Altenburg; Dr. Reichenow, Berlin; Dr. Rothe, Privy-councillor of Medicine, Altenburg; Chevalier von Tschusi zu Schmidhoffen, Hallein; Dr. Voretzsch, Altenburg; Dr. Leverkuhn, Munich.

Altenburg, December, 1891.

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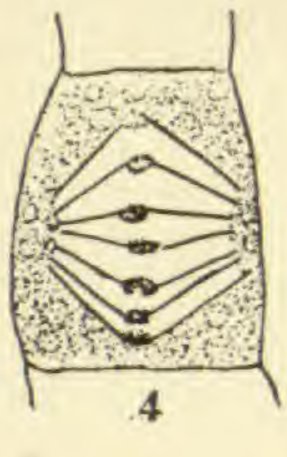
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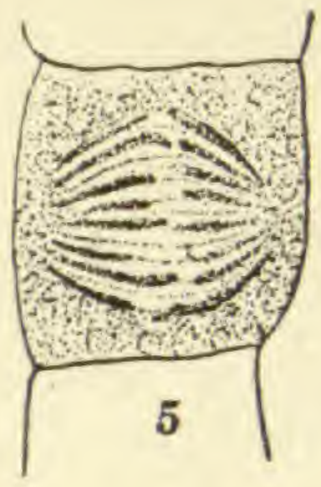
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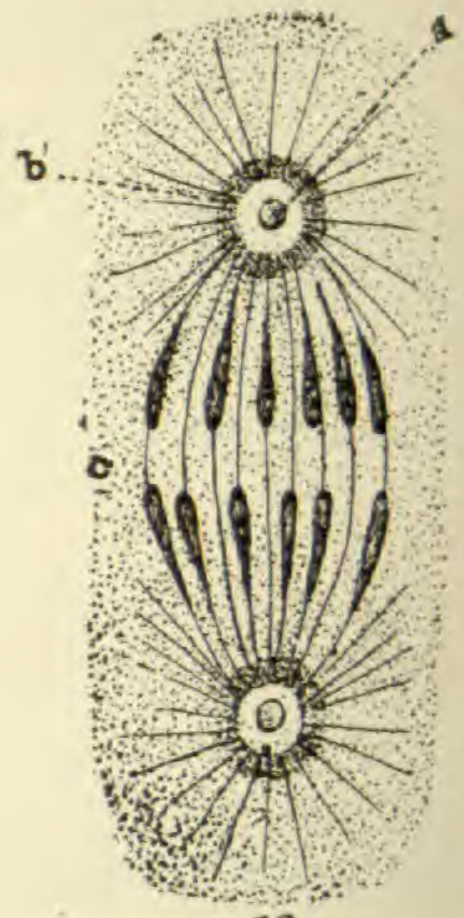

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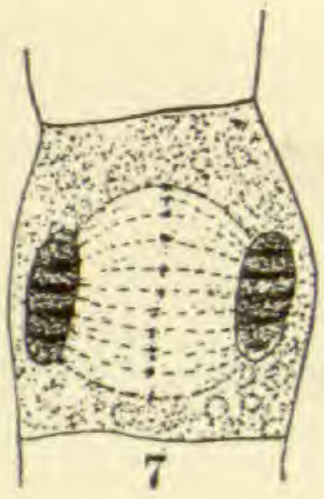
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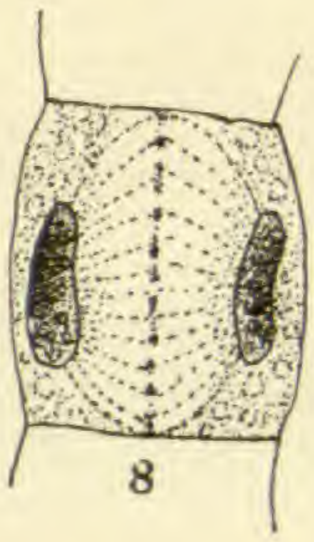
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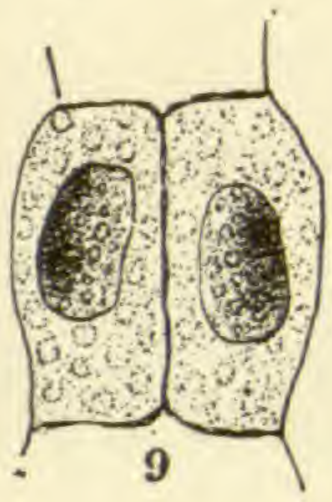
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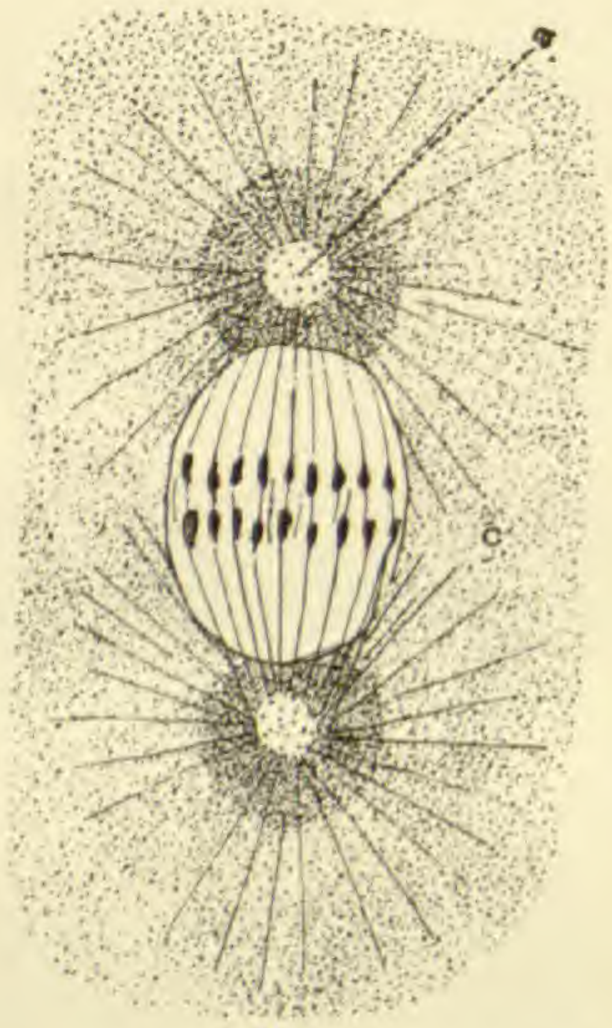

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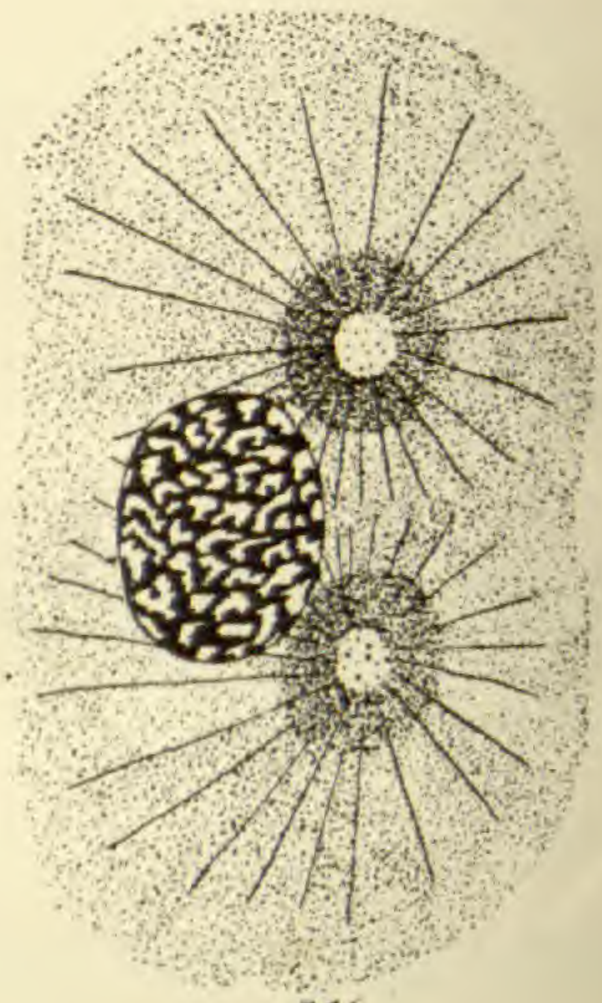
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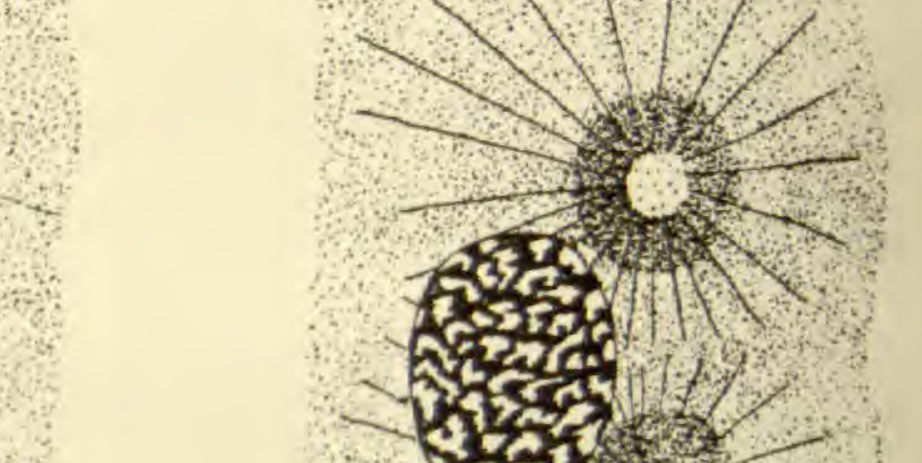

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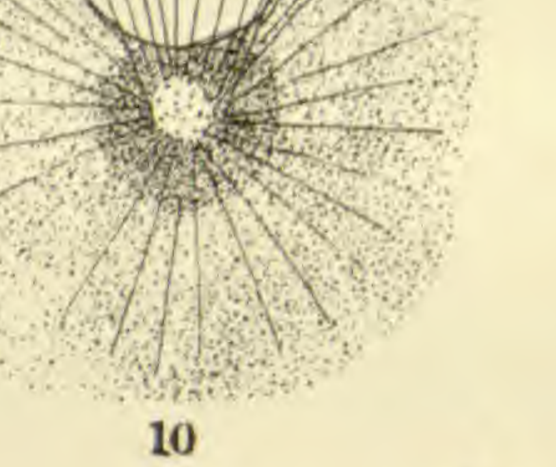
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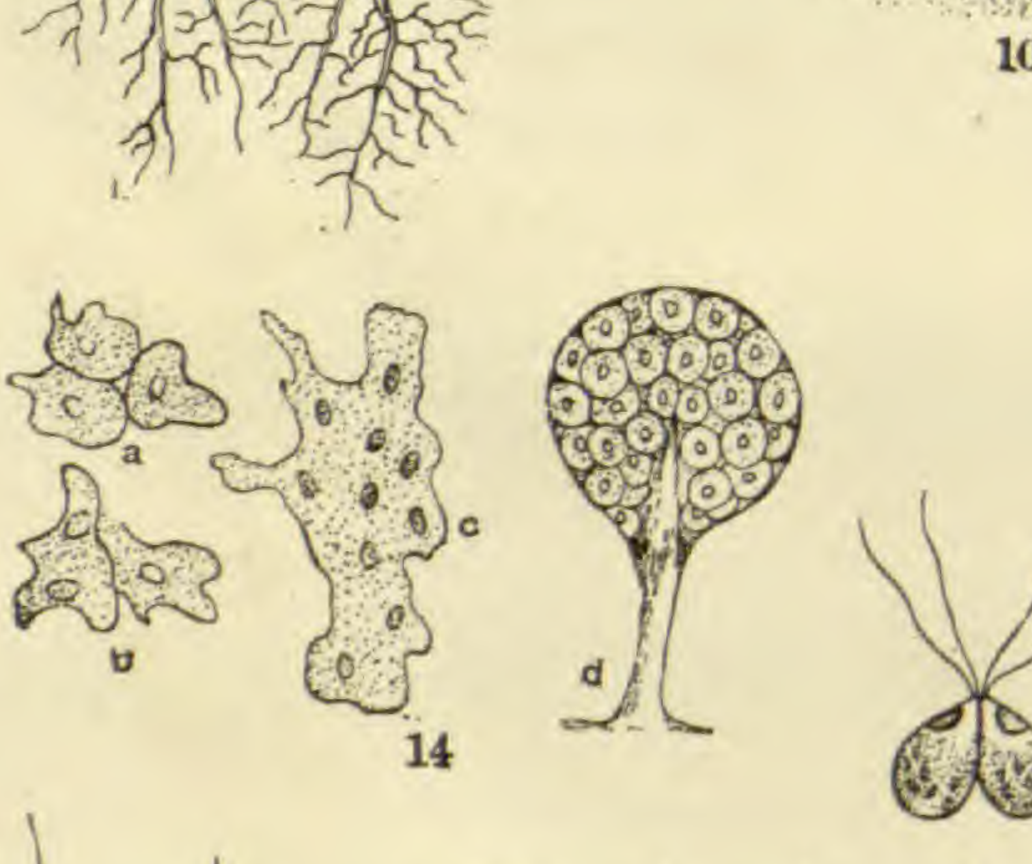

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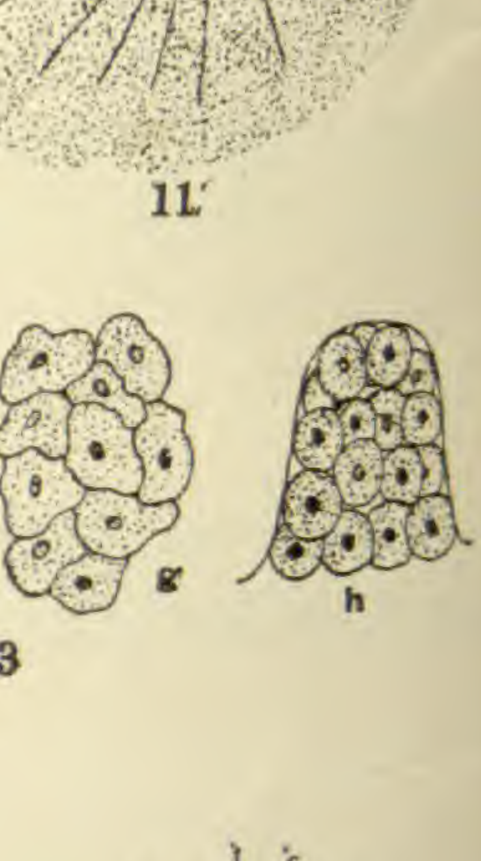
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Fecundation and Development.

THE
AMERICAN NATURALIST

VOL. XXVI. April, 1892. 304

THE TWO SCHOOLS OF PLANT PHYSIOLOGY AS AT PRESENT EXISTING IN GERMANY AND ENGLAND.

BY E. L. GREGORY.

(Continued from p. 217.)

The nature of the experiments will be best understood by a brief statement of the outlines of his theory in regard to the processes by which the water is carried up. He regards the ducts, and to a certain extent, the tracheids, as reservoirs into which the water is passed from the absorbing cells. These ducts, except it may be in a certain period of the year when the so-called root pressure is taking place, are never filled with water but with alternating columns of air and water. All who are at all familiar with this subject will remember that this was the first argument against the new theory. How could the water pass up in the cell lumena when these were not themselves filled? It is claimed now that this very fact is the one which admits of such a possibility. That is, these alternating columns make a combination known as the Jaminschen chain, from the name of the Frenchman, Jamin, who was the first to compute the force exerted by a chain of air and water columns in a capillary tube. Such an apparatus was called by his name, and the discovery of such a system of chains in the ducts and tracheids of woody tissue has been the strong point in the new water theories. The manner of action of this chain may be seen at once, the meniscuses acting as

forces to prevent the motion of the water which would otherwise sink. In other words, the sole function of the chain is to prevent the water from yielding to the action of the gravity. In this way according to the distribution and tension of the air bubbles, the water is more or less evenly distributed throughout the whole stem of the tree and is ready for use whenever needed at different altitudes. The next step in the problem is to discover the factor by which the water is drawn out and set in motion upward. It is here that Professor Schwendener differs from nearly all the younger men who adhere even too zealously to his cause. In short, the last set of experiments which he made were for the purpose of disproving the claims of those who consider themselves able to follow all the successive forces which act in sending the water upward from the root hairs to the transpiring leaves. The question of lumen versus wall was not at all touched by these experiments. On the other hand, they were made to test the length of alternating air and water columns, diameter of tube, etc., and from these results a series of mathematical computations was made, it is true from data more or less uncertain, but yet with such allowances for extreme cases as to prove conclusively that some other force was necessary than those held sufficient by his contemporaries.

Pieces of wood were taken from the inner portions of the trunks of various trees, with apparatus allowing perfectly air tight processes. The pieces were transposed from the tube of the borer into glycerine or water from which all air had been expelled. From these computations it was shown that in no case would it be possible for the action of suction caused by the evaporation from the leaves to reach down much below the crown of the tree, and in case of trees with trunks from 50 to 100 metres long this might be considered proof against the possibility of the force reaching downward until it reaches that effected below by the forces acting in the lower part of the tree. The whole labor is merely to disprove certain theories, not to establish new ones.

In conclusion Professor Schwendener says the results agree with those expressed in 1867. Stated briefly it may be said

they prove that some other forces must be present besides those recognized by authors who claim to give an explanation of the mechanical forces acting in forcing the water upward. These forces must lie more or less scattered through the length of the trunk because they are concentrated at points at considerable distances from each other, and tensions arise which are not present. The Jaminish chain serves to hold the water in the ducts and tracheids from falling by its own weight; the living cells of the medullary rays and of the wood parenchym, in some manner as yet unknown to us, take the water held in these reservoirs and distribute it to places where it is needed.

Now contrast this with the explanation of Sachs, which is virtually the same as that held by all claiming that the wall is the chief path taken by the water in its ascent. This may be stated as follows: Water is able to reach the tops of the trees fast enough to supply the lack caused by transpiration, owing to the peculiar quality residing in the micellæ of the lignified cellulose, which enables the water molecules to move with great rapidity, when the equilbrium is once disturbed by transpiration above. This peculiar quality is entirely lost when once the water has dried out of the walls so the micellæ touch each other. Imbibition may occur as in ordinary cases but the micellæ have lost that character which enabled the water particles to move with such rapidity. One of the favorite experiments given in favor of this theory is that of Th. Hartig with the stick, which being held upright and a drop of water placed on its upper surface, it at once disappears and a drop of water appears below. Now it is admitted that this succeeds only when the wood of the stick is saturated with water. Schwendener's explanation of this phenomenon is extremely simple and takes away all evidence of the rapidly moving particles or molecules of water in the wall. In this saturated condition, there would be continuous water columns inside the tracheids, the cut surface at the top transpires enough to form the concave meniscuses for all these columns, the added drop is sufficient to destroy these meniscuses, the water columns sink until the drop is drawn in and new menis-

cuses again form, preventing farther sinking. In case the wood is partly dried, instead of a drop appearing below, the water at the top sinks in without farther visible result either at once or slowly. In this case there are no continuous water streams as before, they are broken by internal meniscuses forming the chain.

Contrast now the methods of reasoning used in the two cases. It is admitted on both sides that all the mechanical forces here in play whose action we understand, are not sufficient to cause the water to ascend higher than about 30 feet. Sachs, therefore, affirms the presence of a quality in the micellæ of the wood, which if it existed there would account for the water rising. There is no other proof that this quality exists than simply this fact. This statement, perhaps, should be modified by adding, there is no proof which is considered conclusive.

On the other hand, the theory as taught by Schwendener stops short of the assumption of a mechanical cause. No known mechanical forces can be found active here which are sufficient to explain the result. As there is always one factor of whose manner of action we are ignorant, namely: the action of living matter, he assumes this to be the factor which accomplishes that part of the result not reached by mechanical causes. This inference is supported by the arrangement of the living cells in connection with the ducts and tracheids holding the water. For example the presence of wood parenchym around those ducts which are otherwise not in connection with the medullary rays.

In regard to the experiment of Hartig before referred to, it may be of interest to those not familiar with the anatomy of the tissues through which the water passes if a few words of added explanation are given. In the saturated piece of wood we have said there were continuous water columns in the tracheids, these are continuous only in the sense of there being no air columns present. These tracheids are closed cells, therefore there is the interruption of the cell walls at intervals in the otherwise continuous columns. So that according to Schwendener's view all that is proven by the drop of water

experiment is, the amount of resistance of filtration. This in a piece of wood ten metres long in an upright position is less than one atmosphere. Similar experiments have been tried, the stick being placed obliquely; from these it has been proven that a column of water 12 centimetres in height is able to move a water net 100 centimetres or one metre in length.

Now if we turn from the discussion of this old and long disputed question to one of the most recent and perhaps least known, namely: "Turgor as the necessary condition of growth" we shall find the same principle again, only illustrated in a different way.

A cell is said to be be turgescent when the hydrostatic pressure within exceeds that of the atmosphere without. The common teaching regarding the manner of growth of cell wall in surface is, that the cell must be in the turgescent state, that is that the actual growth depends upon and is the result of such condition of cell wall. Owing to the pressure within, the micellæ of the wall are supposed to be separated from each other until the extreme limit of elasticity is reached. In this way place is made for the new particles of matter between the old.

This theory is known in botanical literature as the Sachs-De Vries theory as it was first suggested by Sachs and afterward supported by De Vries. It is often referred to as the one sustained by Naegeli, but a careful study of his works shows that what he says upon this subject has reference to tissue tensions for the most part, rather than to simple turgor.

It is now claimed by Schwendener that there is no proof whatever that the surface growth of the wall depends upon turgor, and on the contrary, that there is considerable evidence against this assumption. For example, it has been shown that cells having an excess of turgor, are not growing at all, while cells are found in a state of great activity whose turgor is very small. One and one-half atmosphere is considered about the medium for ordinary turgescent cells.

Again, in a certain kind of tissue found in stems of water plants and others where large air spaces occur, growth of wall

takes place in direct opposition to a turgor force, that is, the wall grows inward into a cell which is strongly turgescent.

There is also one other ground for the position taken by Schwendener's school in reference to the relation of turgor to growth. This is certain facts connected with what is known as "Gliding growth," "Gleitendes Wachsthum." The principle included in this idea may be briefly explained as follows:

In the early stages of the secondary growth, during the time when the new cells are receiving or taking on their final character as vessels and libriform cells, etc., a growth takes place by means of the walls of one cell gliding along the wall of another. To explain this, it must be assumed that the walls of the young cell consist of two lamellæ; whether this is so from the beginning or not is entirely unknown, but at the stage of the development where the gliding growth begins, the two layers are there. These are not to be distinuguished by the highest power of the microscope, the wall appearing perfectly homogeneous under the most powerful lens. The subsequent growth is such as to prove that there are two lamellæ, as under no other assumption could such growth be possible.

This assumption has also other and positive facts sustaining it, besides the negative one mentioned above. In certain cases the thin young walls of cambium cells have been proven by maceration to consist of two or more lamellæ.

Now according to this principle there must reside in certain growing cells some force entirely independent of the mere mechanical one of pressure. In other words, there is an active as well as passive condition of growth and this active condition depends on certain properties of living matter and these properties are entirely outside and independent of what we know as mechanical force. Again we are brought to the same conclusion as before, there is a force residing in living matter of whose manner of action we are ignorant. That this force exists in this matter we have certain and positive proof.

This subject of turgor as before stated is one of the most recent questions and in a certain sense less important than the standard ones concerning the phenomena of growth.

To treat any one of the latter class fully would require more time than the limits of this paper allow. It is however, in these questions that the peculiar character of the new school is best expressed. The preference given to mechanical questions is evident from the list of subjects previously given as representing the line of physiological teaching Schwendener follows with his present classes. It is in connection with such questions that he has acquired his present reputation, and he is known best through the discussions of mechanical theories which are either peculiarly his own, or in which he opposes those of other leading physiologists.

But it by no means follows from this that he recognizes the mechanical forces as the only ones acting in the plant economy, nor that in his treatment of these, he fails to group their relations to the whole in a way to injure the unity of the entire subject. Rather than this it may be said he gives the first place to such questions because be believes this logical order of all investigation.

If the present aim of the scientist be to trace all the processes of living matter back to the action of chemical and physical forces, how can this result be reached unless we begin with the study of those laws whose action we know and understand?

It is in this sense that he says we are yet far from being able to take up the subtle and delicate questions connected with the action of living matter. There are many problems whose solutions lie nearer to us, and on these solutions depend our ability to handle the more remote and difficult questions of plant physiology.

One single illustration of what is here claimed may be found in what he says of the expression "Mechanics of Growth." Of this he says, "There is no such thing as the mechanics of growth, for it is the immediate result of the action of living matter and of this action we are ignorant."

In answer to a possible criticism as to there being but two main sources of the principles of plant physiology as they are now taught in Germany and England it may be said: there is

no question regarding the position occupied by Schwendener as leading the modern school in Germany.

In reference to the influence of Sachs on the leading text books of the present day, this is even more evident. While many other men of eminence in this field have contributed the results of their labors, not only by original research but also by writing text books, it is as yet true that they differ but little in methods of work or in the results obtained, from those general methods and principles which were first disseminated from the laboratory of Würzburg from the pen of the most popular and brilliant writer the world has yet produced in this special field of investigation.

In conclusion, therefore, it remains only to contrast once more, briefly the leading features of both schools.

In the one there is a tendency to put mere speculation and fanciful conjecture in the place of theory. Rather than to admit our present ignorance and weakness, effects are sometimes referred to causes which cannot be proven in harmony with those laws of nature which are recognized in other departments of natural science.

In the other the principal lines of research are in the direction of mechanical questions, but at the same time there is a clear and distinct recognition of our present limitations and of the relative value of such questions in the ultimate determination of the action of forces which are yet beyond our reach.

To the botanists of the present day and the future it remains to verify and reject, choosing the true and rejecting the false from both lines of research, till the decisions of the future shall make clear how much of error yet clings to the old school and the new.

PHENOMENA AND DEVELOPMENT OF FECUNDATION.

By H. J. Webber.

(*Continued from page* 111.)

ORIGIN OF FECUNDATION.

Having now discussed shortly the nature of the sexes and the effect of environment on them, we are ready to inquire into the origin of fecundation. There are several well-marked stages which we may select, that appear to indicate the probable course of the development.

1. Among certain of the *Mycetozoa* or *Myxomycetes*, the Slime Molds, we find some very suggestive forms that are apparently near the beginning of the differentiation. They are even more interesting, if possible, coming as they do from a class of organisms placed in either kingdom as the lowest group, their animal or vegetable nature being in question, although authorities seem to incline toward believing them of slightly preponderating animal nature. In the lower Slime Molds belonging to the group *Acrasieæ*, the life history is shortly this: From the spore (fig. 13, *a*), on germination there creeps out a naked motile mass of protoplasm, which takes nourishment, grows and reproduces rapidly by dividing, the products of the division being in each case similar swarm spores (fig. 13, *b–f*). After an extended vegetation of this sort, a number of the swarm spores collect into a "herd" and creep about in company for a time, after which two of them, apparently through accident, come closer together and adhere. Now the others close in and unite with these two, forming what is termed a *plasmodium* (fig. 13, *g*). But in this union each swarm spore retains its individuality, the union being merely an adhesion, not even a fusion of the individual protoplasms. They creep around in this plasmodium form for a time until ready to complete the cycle by forming the mature stage, which is accomplished by the plasmodium coming to rest,

collecting into a conical mass and each original swarm spore forming a single encysted spore (fig. 13, *h*).

Why this mechanical adhesion of the swarm spores into a plasmodium? It would seem a scheme adopted by the plant to better protect the encysted spores.

2. In the *Myxomycetes* proper (the higher Slime Molds), the mode of life is practically the same as in the *Acrasieæ*, but here, when the swarm spores fuse to form the plasmodium; the fusion is complete so far as the protoplasms are concerned, but still there is a lack of a thorough fusion of all the elements as the nuclei remain apparently ununited (fig. 14).

In some *Myxomycetes* we find an indefinite number of swarm spores uniting to form the plasmodium, but in others the number thus fusing is reduced to a very few. Thus coupled with the growing complexity of the fusion or *pseudo-conjugation* of the swarm spores we have a reduction, also, in the number of elements fusing.

3. Between this process and that described as conjugation there are many interesting intermediate forms. Sometimes three or four spores of low Algæ unite as if to gather sufficient strength to make a combined start in life. In *Dictyosiphon hippuroides* Areschoug[1] has observed and figured the union of three zoospores. In *Acetabularia mediterranea* DeBary and Strasburger[2] have figured the copulation of several swarm spores (figs. 15 and 16). This multiple conjugation has also been observed in *Hydrodictyon*, *Spirogyra* and some other algæ, and while considered as abnormal, is apparently by no means uncommon. Among animals the young form of the sun animalcule (*Actinosphærium*) though usually uniting in twos, have been observed by Gabriel to sometimes exhibit multiple conjugation. In this stage the number uniting is reduced to a very few, usually not more than three or four, and is probably accompanied by nucle fusion.

4. In *Ulothrix* we find the differentiation carried still further. Here the protoplasm of certain cells of the parent plant divides up into numerous little pyriform bodies (fig. 17), which

[1]Areschoug, Nova Acta., Reg. Soc. Ser. III, vol. x. Upsaliæ 1875.

[2]DeBary and Strasburger Bot. Zeit., Bd. xxxv (1877), p. 714.

on breaking out of the mother cell are seen to possess on their anterior end an eye spot and two cilia, by the rotation of which they dart actively here and there. These are the so-called *microzoospores.* Finally two of them from different parents, but in appearance precisely the same, come together and coalesce, their nuclei in this case, as in the last, probably fusing, but here only two uniting; while in the preceding stage there were more than two. This process we term conjugation, being the coalescence of two cells externally quite similar.

5. The next stage in the development is the union of more or less dimorphic elements. Both among plants and animals naturalists are agreed that it is impossible to draw any marked line of distinction between this and the preceding stage or conjugation. Sachs says "this differentiation presents a most complete series of gradations between the conjugation of similar cells and the fertilization of oospores by antherozooids, any boundary line betwen these processes being unnatural and artificial."

Cutleria, a seaweed of the branch *Oophyta,* is an interesting example of this stage. Here the female zoospores are large and borne singly in specialized cells in the parent. These on escaping, swim about for a time as do the microzoospores of *Ulothrix,* after which they come to rest. The smaller antherozooids now approach and conjugation takes place. In *Cutleria,* then, we have a union of differentiated cells for the first time, but they are yet both motile.

6. As an illustration of the next stage where we find complete differentiation as marked as in man, we select the Moss plant. In the mosses, the male and female organs are commonly borne on different plants. The egg cell is located at the bottom of a flask-shaped organ, the archegonium (fig. 18, *a*). The antherozooids (fig. 18, *b*) are small headed and biciliated, approaching in appearance very near to the spermatozoa of higher animals. In fertilization the antherozooids swim to and down the neck of the archegonium, at the bottom of which they find the quiescent oosphere or egg cell with which they fuse. The sexual cells of the moss plant, it is thus seen, unite two and two, as in the last case, but the differentia-

tion has been carried further, the female having become wholly incapable of independent motion, and the antherozooids have been gradually decreasing in comparative size. Here we have reached as high a development of fecundation as is probably found in the vegetable kingdom. (The stages in this development may be made clear by an examination of fig. 20, which is a modification of an illustrative diagram designed by Geddes and Thomson.)

I trust I have now made clear to you how fecundation probably originated, or rather the course it likely pursued in its gradual differentiation. Cell division, as we have seen, originated in almost a mechanical breaking apart of a mass of protoplasm. Conjugation and fecundation we now see, probably originated in the almost mechanical adhesion of the swarm spores of the *Acrasieæ*, followed by the mechanical fusion of the swarm spores of *Myxomycetes*, and gradually increasing in complexity until there is complete fusion (conjugation), then a fusion of elements differing in character. *Which is fecundation.*

DIFFERENTIATION OF SEX.

We may now direct our inquiry to the point in this evolution where sex becomes differentiated. In the conjugating swarm spores of the *Slime Molds* there seems to be no point where we can detect indications of a difference in the uniting individuals. So far as known there is no differentiation into male and female.

In *Ulothrix* (fig. 17) we begin to get a differentiation. In the conjugating microzoospores or planogametes (so called because of their similar character), it has been observed that planogametes produced in the same organ or gametangium will not coalesce with each other, but coalesce with planogametes from other gametangia. Here then, where the microscope fails to reveal any difference in the conjugating cells we nevertheless know from this fact that there must be some difference.

Ectocarpus siliculosus, one of the brown seaweeds, from the observations of Berthold, illustrates a rather different feature, by which we determine that the planogametes are really male

and female, although from external appearances we cannot recognize the difference between them. When the zoospores or planogametes are discharged from the mother cell, they do not differ by any morphological character. The females do not attract the males, but they swim around in the water and pass each other unnoticed. After a time, however, sex becomes manifest, and notably in accordance with the anabolic character of the female. Certain ones of the planogametes become motionless, draw in their cilia and assume a rounded shape (fig. 19, *a–c*). The female character of such cells is shown by the attraction they exert on the active males which collect about them in great numbers (a hundred or more), clustering at one side in a half circle. The anterior filament of each male is directed toward the female cell and is kept continually moving back and forth over it, the object being, it is thought, to provoke in the female planogamete genital excitation (fig. 19, *d*). After continuing to stroke the female for a time, one of the male planogametes leaves the circle and approaches the female, with which it gradually fuses, and fertilization is complete (fig. 19, *e–h*).

In the pond scums (*Spirogyra*, etc.), the reproduction of which is probably familiar to all, the filaments appear exactly alike, but the female character of one is shown by the cells of that filament containing all the spores resulting from the conjugation.

In *Cutleria*, mentioned above, the difference is manifested by the size of the conjugating cells, but as we noticed, both male and female are still motile.

In the common rock weed, (*Fucus*—fig. 21), the differentiation becomes marked by the external forms of the sexual cells. The female cells are large and motionless, while the male cells are becoming more intensely male by a comparative decrease in size and increase, if anything, in vigor. By the vigor of their motions they give the oosphere, around which they collect in great numbers, a rotary motion for a time until it is fertilized.

In the *mosses* (fig. 18) and *ferns*, discussed above, we reach a complete and highly developed state of sexuality, probably more complete than in the higher flowering plants.

We have now traced hastily the course of the differentiation into the sexes, but the question "what causes this differentiation?" remains.

Starting with an amœboid cell let us see what changes environment might bring about in this direction. We have already seen that nourishment evidently has considerable to do in the determination of sex. Now the physiological conditions in reference to nourishment to which a cell may be subjected are evidently three: preponderating anabolism, preponderating katabolism or a medium between these when katabolism and anabolism are equal. Suppose an amœboid cell is subject to a preponderance of anabolism over katabolism the result would naturally be, increase in size, accompanied by a growing regularity of outline, increase in reserve food material and decreased mobility. The result is surely plain, we would have differentiated an *ovum* or egg cell. On the other hand subject the amœboid cell to preponderant katabolism, and we would as reasonably expect a decrease in size and in reserve materials accompanied by increased activity and the development of organs to aid in more rapid motion through the surrounding medium. In short in this manner we reach intelligibly the differentiation of sperm and ovum, antherozoid and oosphere (fig. 60, and explanations).

THE TWO SEXUAL ACTS IN SEA WEEDS.

In certain of the Red Seaweeds we appear to have the curious and unparalleled occurence of two sexual acts in the life cycle of the plant, and the manner in which it is lead up to by transitional forms is very suggestive. The female reproductive organs which are borne on the same plant as the antheridia or on different ones consists usually of a group of cells, the *procarpium*, from one of which the egg cell proper, a long continuous closed tube, the trichogyne, grows out. In fertilization the spermatia are wafted about in the water until they come in contact with the trichogyne to which they adhere. The walls at the point of contact are absorbed, allowing the nucleus of the spermatia to pass over into the trichogyne and thus down to the egg cell, where it unites with the female pronu-

cleus (figs. 22 and 23). Shortly after fertilization a partition forms between the trichogyne and the egg cell, debarring the entrance of further spermatia and affording thus an excellent illustration of what Whitman has termed "Self-regulating receptivity." After fertilization the egg cell does not separate from its previous tissue connections, as in the oogonia of other green algæ, and the archegonia of the archegoniata, but remains in continuous connection with the hypogynal cells through which it is nourished.

In the simplest case (*Helminthocladieæ*) the ovacell develops from its surface many several-celled filaments, *ooblastemas*, as they are called, which form usually a closely compressed tuft. A single carpospore is developed at the apex of each of these ooblastema filaments (*Nemalion*, etc.) In this case, it will be noticed, all the ooblastema filaments are nourished through the egg cell.

In the *Gelideæ*, a slightly higher form, the fertilized ova from its surface cell develops a single filament, termed the ooblastema, which turns toward the axis of the branch and, ramifying abundantly, winds around this, sending branches into the highly nutritive outer layer of cells of the branch and connecting with some of these cells by the development of pits. Being thus abundantly nourished through this tissue, the branches of the ooblastema filament develop from each of the clavate erect terminal branch cells, either a single spore or short chains of two or more. In this case it is seen the ooblastema filament becomes in a sense parasitic upon the tissue of the parent plant.

In the families *Crytonemieæ* and *Squamarieæ* a single or at least few ooblastema filaments develop from the fertilized egg cell. These creep about until they come in contact with certain specialized cells of the branch known as auxiliary cells, with which they enter into connection directly or by the development of conjugation processes. In many cases the union thus formed is limited to a fusion of the protoplasm while the cell nuclei remain separate, (*Dudresnaya*). In this case a process issues laterally from that half of the conjugation

cell which represents the ooblastema cell which by its further growth gives rise to the spore complex (fig. 22).

In other cases (*Gloeosiphonia*) when the contents of the ooblastema filaments flow into the auxiliary cell, the *nuclei unite*, the fusion or conjugation being thus complete. In this case the auxiliary cell separates off as an individual cell and gives rise to a lateral cell which becomes the centre of a spore complex (fig. 23).

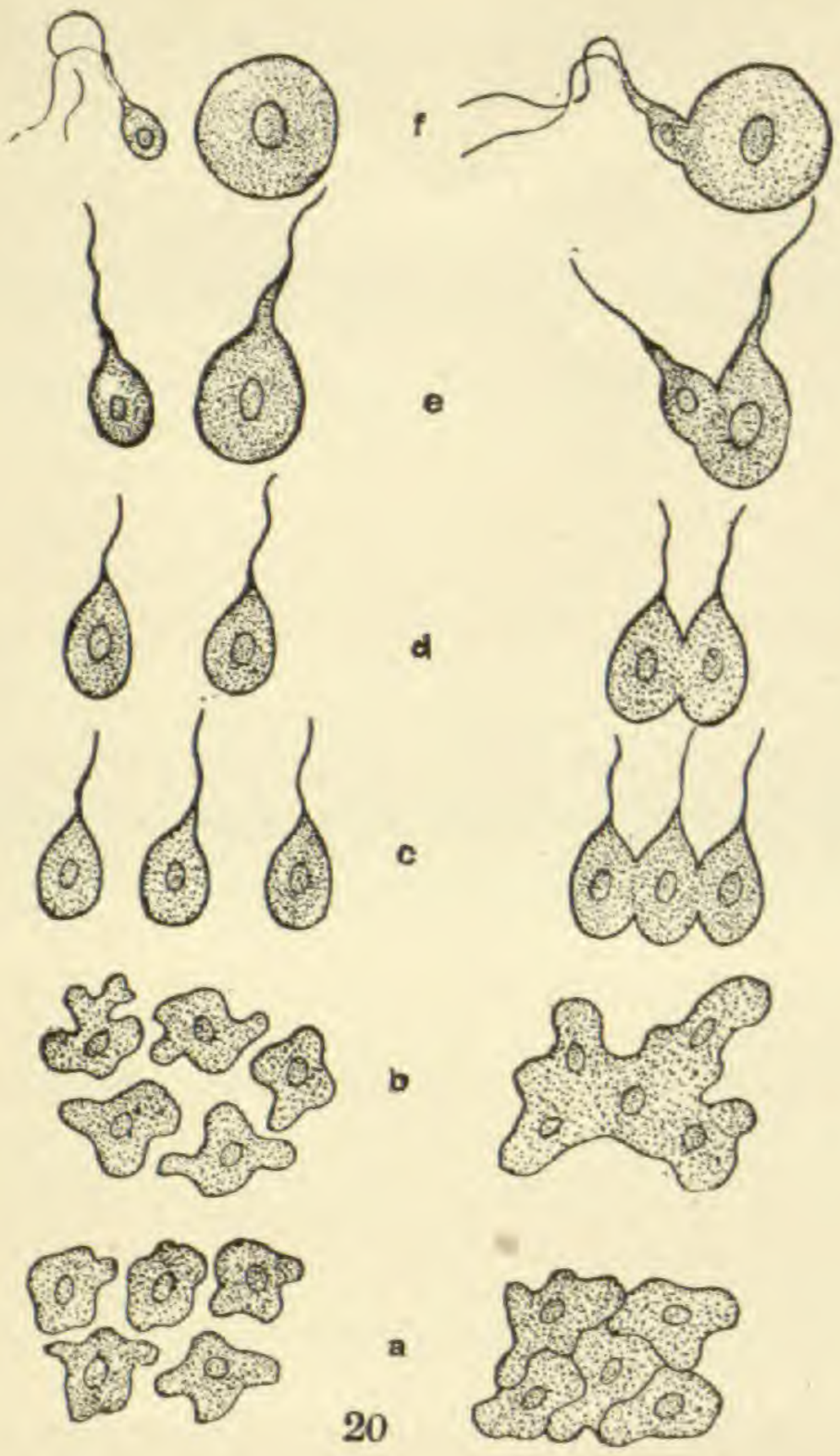
In the above case where the nuclei unite and where the conjugation gives an impulse to further development in the auxiliary cell, which otherwise would have remained quiescent, we have a case fulfilling all the requirements of a true sexual act,—true fecundation, and there seems to be no other way to consider this, than that here we have in the life cycle of the plant, two entirely different sexual acts, one following the other. We are surprised at this unprecedented phenomenon but we can not predicate why it should not occur. The reason for it we may assign to natural selection and development along natural lines. (1) The spores develop at the ends of filaments grown out from the egg cell. (2) The filaments thus formed begin to attach themselves to cells of the branch for nourishment. (3) We find special cells developed which the ooblastema filament finds and unites with in one sense but giving no nuclear union. (4) The ooblastema strikes a specialized cell with which it unites nuclei and protoplasm, the conjugation being complete and the further development from this auxiliary cell. May we not here in the development of the second sexual act of the Red Seaweeds derive a hint as to the physiological meaning of fecundation.

We start in a union for nutrition. We end with conjugation.

FECUNDATION IN ANIMALS.

Character of Ovum.—The animal egg or ovum presents all the characteristics of a normal somatic cell. The rather large nucleus is situated approximately in the centre of the cell, surrounded by abundant protoplasm. The abundant chromatin of the nucleus is arranged as in other cells in the form of a tangled coil like a disordered ball of twine. It is thought by

PLATE XII.



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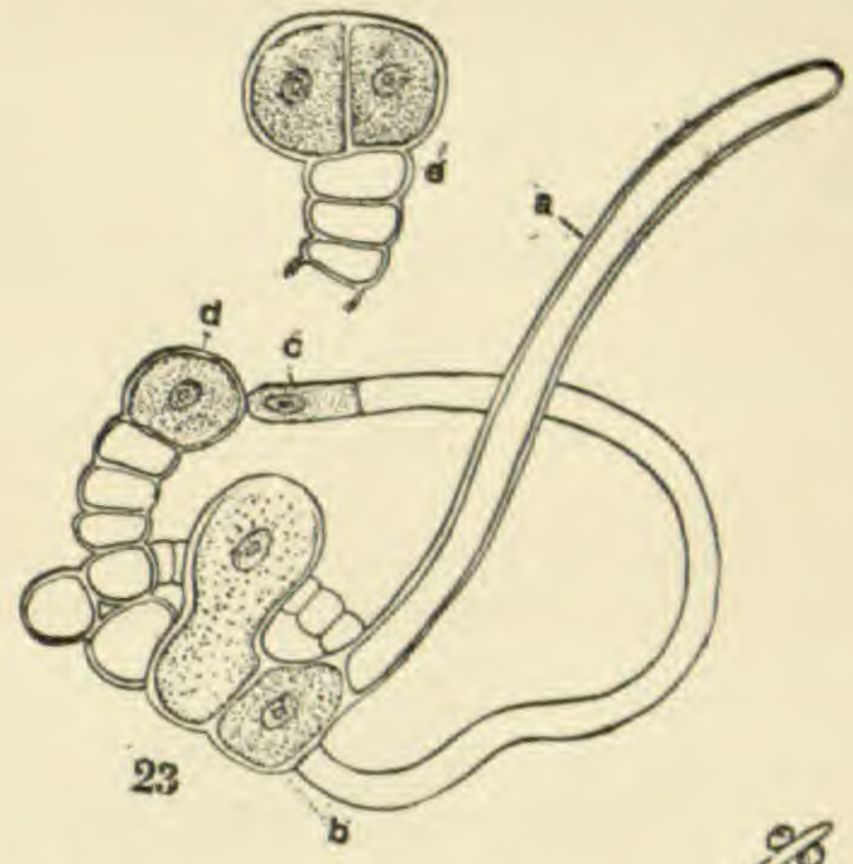

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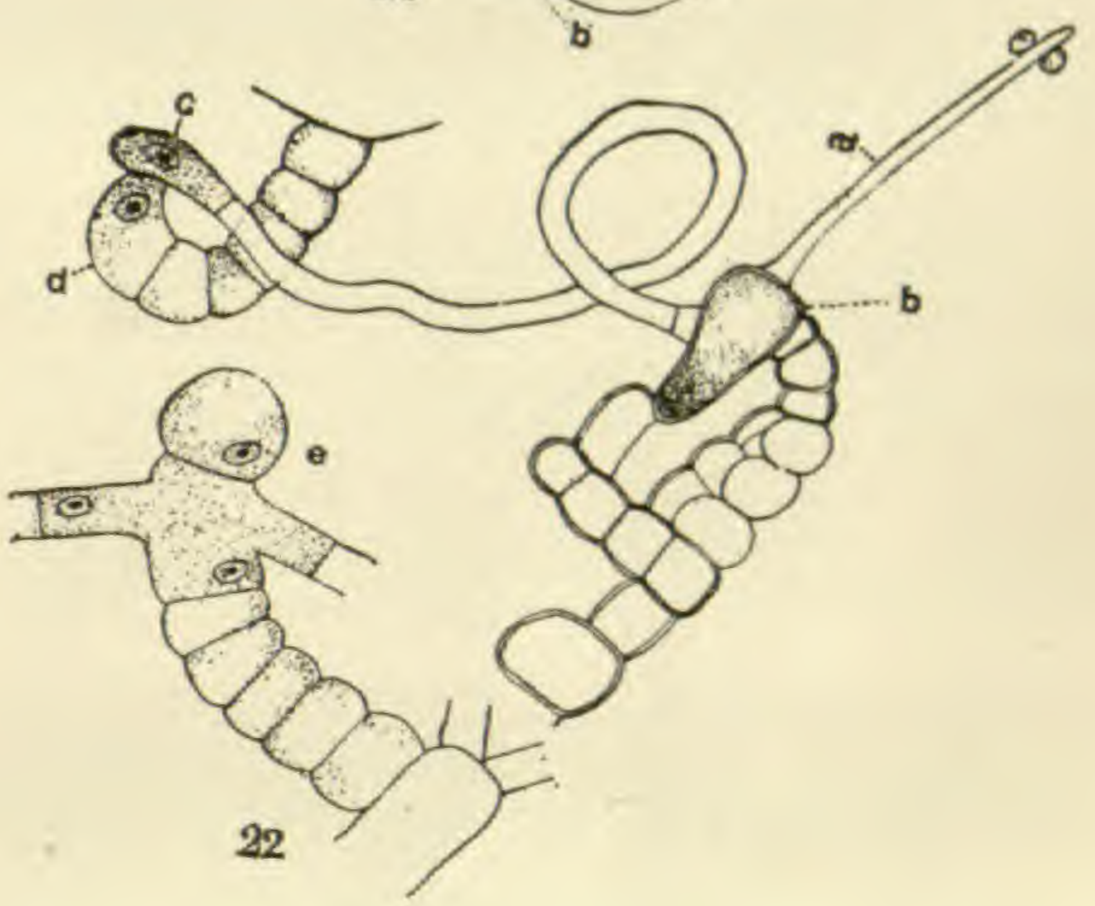

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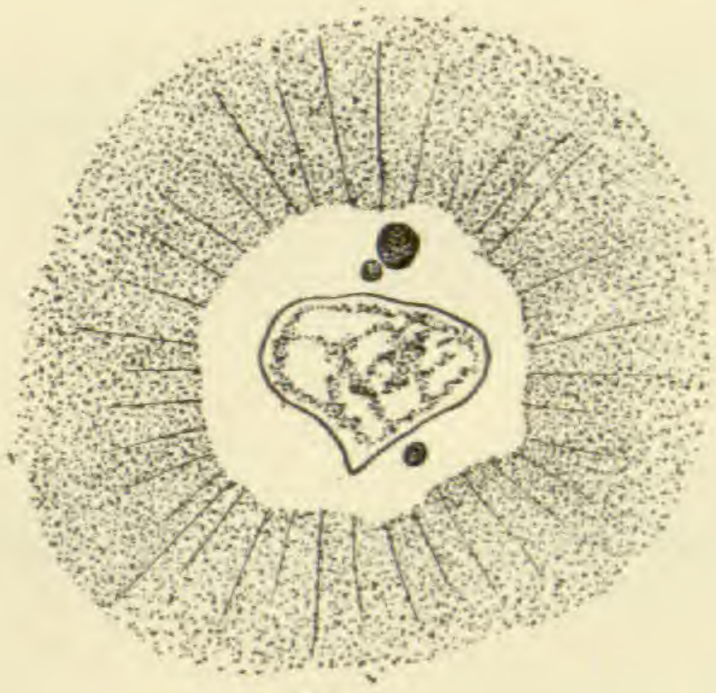

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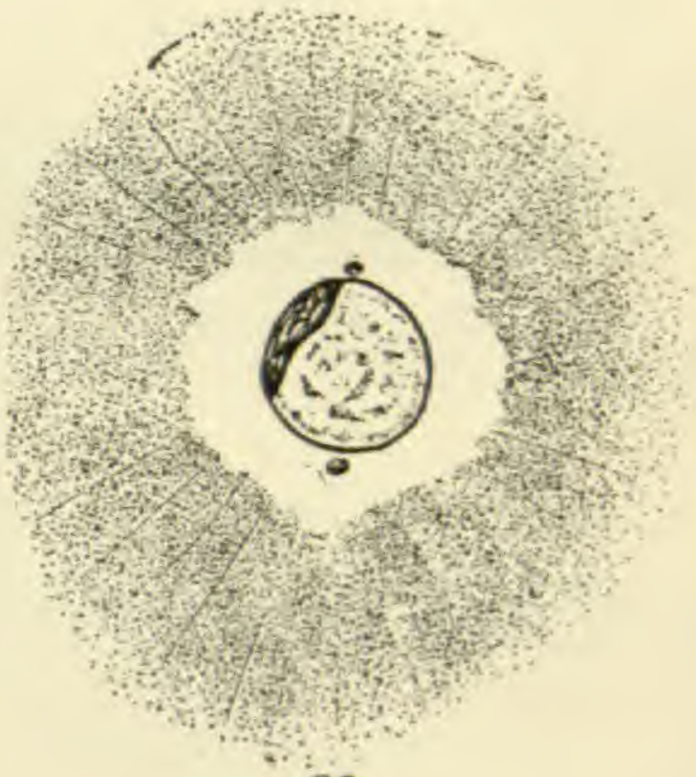

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Fecundation and Development.

some, Van Beneden and others, to be continuous, but by Boveri and his followers it is maintained to be interrupted. This matters little, however, as the ultimate division of the coil is into a definite and regular number.

When the egg cell has attained its mature size, a peculiar occurence takes place. The nucleus approaches the wall, forms a spindle and divides, forming at one side of the large ovum a tiny cell, containing half the nuclear matter and a small quantity of protoplasm from the ovum. This is not all, later a second spindle is formed and again the nucleus of the ovum divides throwing off another small cell. These cells thus given off from the ovum are known as *polar globules.* These little bodies, long passed by as of no importance, have by the masterly studies of later authors, foremost among whom are Van Beneden, Boveri and Weismann, been raised to a most important position and are intimately connected with late theories of fecundation.

Minot's Theory of Polar Globules.—What we may term Minot's theory assumes that in the cells both sexes are potentially present. To produce sexual elements the cell divides into its parts; in the case of the egg cell the male polar globules are cast off leaving the female ovum. In parthenogenetic ova he supposes that enough male matter is retained since only one polar globule appears to be formed. Van Beneden is also inclined to regard polar globules as eliminated male matter. Minot's theory then is that in every cell of every organism having sexual reproduction that there is an equal amount of female and of male matter, an equal number of male and of female chromatin bands; and that before the egg can be fertilized, it throws off the male matter that it contains as polar globules, so that the pronucleus consists merely of the female matter, of half the ordinary number of chromatin bands. The spermatozoön which has eliminated all female matter, enters and supplies the required amount of male matter. So that in the fecundated nucleus thus formed we have again the normal number of male and female chromatin segments from the different parents, and this nucleus by its segmentation forms every cell of the new organism. So

from this theory we arrive at an intelligible reason why the offspring comes to resemble both parents but there are difficulties in the way of further tracing heredity which we have not time here to consider.

Weismann's Theory.—Weismann's view is wholly different. He distinguishes in the ovum two kinds of plasm, the germ plasm and the histogenetic or ovogenetic nucleoplasm. The germ plasm which is at first present in the young egg he concludes originates first of all a special histogenetic or ovogenetic nucleoplasm which controls the egg cell up to the point of maturity, enabling it to secrete food material, develop membranes, etc. At maturity this ovogenetic nucleoplasm is of no more use and incapable of retransformation into germ plasm, and is hence thrown off by nuclear division forming the first polar globule. This is all that is extruded in the parthenogenetic ova. The second kind,—his germ plasm,—present in the egg, is that which enables the ovum to develop into an embryo. The second extrusion of a polar globule is a reduction of this germ plasm of the nucleus by half and the same must occur in the male germ cell also. What is thus lost in the formation of the second polar globule, is supplied by the fertilizing spermatozoön. The beginning of development depends, according to this hypothesis, upon the presence of a definite quantity of germ plasm. This the normal egg attains by first losing half and then regaining it; while the parthenogenetic egg attains the same result by never losing any. According to Weismann's view we see that only the second polar globule has to do directly with reproduction and here we have to look for an explanation of reproduction and heredity. As mentioned above Weismann looks upon the second polar globule, by which the germ plasm is reduced one half, as a reduction not only in quantity but above all in complexity of constitution, for by this means, he reasons, the excessive accumulations of different kinds of hereditary tendencies or germ plasms is prevented, which without it would necessarily be produced by fertilization. With the nucleus of the second polar body as many different kinds of germ plasms are removed from the egg as will be afterward added through the sperm nucleus. This

will likely need illustration to make it plain. Suppose we imagine an organism in which sex has just arisen and we thus have fertilization for the first time. In the egg cell resulting from this fertilization we would have mingled the germ plasms of but two parents, or but two kinds of chromatin in the nucleus; the chromatin, be it remembered, being the organ to which all such phenomena are traced. This daughter organism now conjugates with another similar individual which is also but one generation removed from the sexual origin. In the organism resulting from this union we obviously have commingled in the chromatin elements four ancestral tendencies or idioplasms. It is unnecessary to carry this further, obviously the next generation form a similar union, would contain 8 ancestral idioplasms, the next 16, the 10th generation 1024, and so on, doubling each time with every sexually produced generation. It is merely following the well known calculation made by breeders who merely differ in that they use the term blood, half blood or quarter blood, instead of germ, plasm or idioplasms as we have.

While in each succeeding generation the number of germ plasms are doubled, their quantities are reduced by one-half. Thus in a series of generations the continually recurring divisions of the ancestral germ plasms must theoretically ultimately reach a limit. So Weismann argues that the reduction in the number of chromatin bands accomplished by the formation of the second polar globule is to reduce by one-half the number of the ancestral germ plasms in the ovum, and the ancestral germ plasm added by the spermatozoan brings the number of germ plasms in the ovum up to the normal number which he supposes to be present. This theory is of course based on the almost universally accepted theory that fertilization consists in that an equal number of chromatin loops from either parent are placed side by side and form the new segmentation nucleus.

Character of Sperm.—The character of the spermatozoön is familiar to all. It consists of a minute head, composed chiefly of chromatin nuclear matter with a minimum allowance of cytoplasm and a long contractile tail which working behind

like a screw propeller, moves the essential head through the water or along the ducts.

Fertilization consists in a union of the spermatozoön with the ovum. Many devices are developed to bring the two cells near together, but they are then left to conjugate at will, as it were. The road that it is necessary for the spermatozoön to pass over to reach the ovum is frequently quite long, being in the hen about 60 cm. and in large mammifers from 25–30 cm. But they are katabolic little creatures. It is wonderful how such frail creatures can manage to overcome such obstacles. Henle has seen spermatozoa carry along masses of crystals 10 times larger than themselves. Pouchet has seen them carry bunches of from eight to ten blood corpuscles. They have been estimated to carry burdens four or five times heavier than themselves without much difficulty or inconvenience.

Foll's Observations on the Union of Pronuclei.[1]—Herman Foll describes the phenomena of fecundation in the egg of the sea urchin in about the following manner. The spermatozoön five minutes after entering the egg is conical and from its tip a small corpuscle, the spermocenter is detached (fig. 24). The spermatic pronucleus swells and approaches the female pronucleus the spermocentre in advance (fig. 25). The ovocenter is located on the side of the female pronucleus opposite to the side which gave rise to the polar globules. The spermocenter becomes placed at the pole on the side opposite the ovocenter (fig. 26). There are now two prolonged phases the "solar" and the "aureolar;" at the end of the first of these the ovocenter and spermocenter becomes divided in the form of "halters," as the author expresses it, which are not placed in the same plane. These "halters" come to lie parallel to each other in the plane which will be that of the aureole (fig. 27.) In the next phase the spermocenter and ovocenter become divided (fig. 28) and the halves passing in opposite directions along a fourth of a circumference of the combined nucleus arrive at a point at right angles to their previous position. This Foll calls the "Marche du quadrille."

[1]Herman Foll. "Contribution a l'historie de la fècondation," Comptes Rendus Sci. T. cxii (Avril 1891), p. 877.

At the moment when the demiovocenters and demispermocenters are on the point of uniting, the aureole rapidly disappear and true aster become apparent with their perfectly distinct fibrils, much different from the radiations which are visible till then (fig. 29). The demicenters unite and fuse to form the first asterocenters.

The author concludes that fecundation consists not only in the addition of two nuclei arising from different individuals of different sexes, but in the union of two demispermocenters with two demi-ovocentres to form the first two astrocenters. All succeeding astrocenters are derived in equal parts from the mother and father.

Fecundation in Higher Plants.

Development of Embryo Sac and Egg Apparatus:—In the higher plants (the anthophytes or spermophytes) we are particularly concerned with the embryo sac and its inclosed egg apparatus. It is necessary that we should thoroughly understand its development. The embryo sac first shows itself as an enlarged specialized cell in the upper central part of the nucellus or body of the ovule (fig. 30, a). In the maturation the nucleus divides and the two daughter nuclei thus formed travel in opposite directions, one going to the apex, the other to the base of the embryo sac which has, in the meantime, been growing larger and longer (fig. 31). After reaching their respective ends each divide again (figs. 32 and 33) and the two in each end thus formed again divide (fig. 34) forming a tetrad of nuclei at both the apex and the base of the embryo sac. Now a very peculiar thing happens. One of the nuclei from each tetrad thus formed leaves its position and journeys toward the centre of the embryo sac where they come together and fuse, forming the nucleus proper of the embryo sac (fig. 35, c). There is now left at each end of the embryo sac three nuclei of the original tetrad. The nuclei of the upper end become partitioned off by walls and form the egg apparatus proper. The two upper cells, the so-called *synergidæ* or accessory cells (fig. 35, a) are of doubtful function, being merely of secondary value in fertilization. They are some-

times capable, it has been observed, of being fertilized as egg cells and developing embryos (in cases of polyembryony). The lower cell (fig. 35, b) is the egg cell proper. The three basal cells become partitioned off by walls also and are known as antipodal cells; they appear to have no function in fertilization (fig. 35, d).

Development of Pollen:—The pollen or male germ cells are produced in great quantities in the pollen sacs of the anthers. They are formed in mother cells by two successive divisions of the nucleus, thus there are four pollen grains produced in each pollen mother cell (figs. 49 to 55). Later the nucleus of the pollen grains thus formed divides again (fig. 39) forming two cells in the grain, a small and a large one, the so-called generative and vegetative cells. The generative nucleus (fig. 40, b) of the small cell is the one important in fecundation. The vegetative nucleus (fig. 40, a) remains in the pollen grain having no further role in fecundation, or according to Guignard, sometimes passes into the pollen tube in advance of the generative nucleus and follows down the tube as it lengthens, until the micropyle is reached, when it gradually disorganizes and before fertilization takes place has disappeared. At first these two nuclei are separated by a cell wall but sooner or later the wall is broken down allowing the two nuclei to float free in the protoplasm of the pollen grain.

Reduction of the Number of Chromatin Elements in Sexual Nuclei.—Guignard[1] in a late article has emphasized the fact that in sexual cells there is a reduction in the number of the chromatin segments. In somatic cells he finds usually 24 segments, in the sexual cells the number is reduced to 12. In the formation of the young tissue of the anther 24 bands are uniformly present as far as the mother cells, the nucleus of which receives, as have the others so far 24 segments. After the complete differentiation of the mother cell it relapses for a time into a state of repose before the two divisions which are to form the pollen grain. When now the nucleus of the mother cell begins to manifest division it shows all the normal

[1]Guignard, "Sur la Constitution des Noyaux Sexuels ches les Vegetaux," Comptes Rendus, Soc. de Biol. 22. Mai 1891.—Annal des Sci. Nat. Bot. l. c.

changes of karyokenetic division but when the chromatin segments become visible there are only 12. The 12 segments are found again in the division which succeeds in order to form the pollen grain. Guignard assumes that during the formation of the mother cell the segments have united two and two either end to end or parallel; thus giving only 12. He thinks it certain that this reduction in number can in no way be connected with the elimination of nuclear, matter as seen in polar globules.

In the nucellus of the ovule the nuclei all possess alike 24 chromatin segments. The cell which differentiates to form the embryo sac contains a nucleus which receives 24 chromatin segments but when the nucleus of this divides, after a long state of repose, they show a reduction, as in the pollen, from 24 to 12 segments and these 12 segments are found in all the succeeding divisions in the formation of the egg apparatus. A similar phenomenal reduction is said by Hertwig to occur in the animal kingdom, in the course of development of *Ascaris megalocephala.*

Germination of Pollen and Growth of Pollen Tube :—The act of fecundation proper consists in the union of the male nucleus of the pollen grain with the female nucleus of the egg cell. The mature pollen is transported from the anther where it is formed, to the stigma by the aid of insects, wind, water, etc. We are all, thanks to such men as Darwin and Lobbock, more or less familiar with the various processes by which pollination is accomplished. The pollen brought in contact with the stigma adheres there, being held and excited to germinate by a sticky, sugary exudation which covers the stigmatic surface.

In germination the pollen grain sends out a tube which grows down through the tissue of the style till it reaches the micropyle or entrance to the ovule through which it passes, enters the nucellus or body of the ovule, and comes in contact with the embryo sac, at the upper point where the egg apparatus is situated (figs. 36 and 37). It may well be asked how the pollen tubes in their blind chase downward succeed in finding such a small place as the micropyle and a single

cell in the body of the ovule. How in the inverted ovule they grow downward and then turn and retrace their steps upward; and the same question might properly be asked in regard to the lower plants. How does the antherozoöid of *Fucus* succeed in finding the oosphere which is floating, perhaps, at some distance in the water, or the antherozoöid of a moss plant, the small mouth of the archegonium which is on a different plant. As to this we can only suggest. It has been thought that in such cases the ovum secretes some substance which acts as a chemical excitant on the antherozoöids. Pfeffer working from this suggestion, has surely observed some interesting phenomena, that much strengthen if not absolutely confirm this hypothesis. His method of experimenting was this:—A solution of the substance to be experimented upon was placed in capillary tubes of from 5–7 hundredths of a millimeter wide. These capillary tubes dip into a watch crystal containing liquid wherein quantities of the antherozoids have been placed. Currants of diffusion will, it is seen, start up between the liquid in the capillary tube and that in the watch crystal, and when the substance experimented upon is the right one the antherozoöids are seen to follow the currents of diffusion and enter the capillary tube. In ferns Pfeffer found malic acid or malate to be the effective substance attracting the antherozoöids. As a proof of this, malic acid is found in abundance in prothallium decoctions of ferns and is known to be of very common occurrence throughout the vegetable kingdom. In the moss plant, cane sugar was found to be the effective substance and substances of the closest analogy as glucose, levulose, glycogen, etc., were found to exercise no attraction. Thus Pfeffer formulated an antherozoöid test for these substances, analogous to the bacteria test for oxygen invented by Englemann.

In the growth of the pollen tube from the stigma downward to the embryo sac, a conducting tissue is formed which accomplishes the same purpose. The conducting tissue consists of layers of specialized cells which become filled with nutritive saccharine material and furnishes nourishment to the pollen tube in its downward growth. Frequently we find continuous

tubes, lined by these specialized nourishing cells, leading from the stigma down to the cavity containing the ovules (fig. 38). In this case the ovary contains usually many ovules, frequently an enormous number, many hundreds indeed, so that it is necessary for many tubes to penetrate the style, as it requires one pollen tube to fertilize an ovule and there can be but little doubt but that almost every ovule formed in the ovary, receives a pollen tube and is fertilized. In the orchids one, by careful dissection, can find a silvery bundle of the pollen tubes and trace their progress from stigma to ovule.

In *Yucca* one can easily trace the long continuous tube that leads from the stigma down through the style, in the lower portion of which it branches into three parts, sending one branch into each cavity of the ovary. The pollen tubes may, with but little difficulty, be traced down through the stylar tube to the ovary cavity and found in numerous cases entering the micropyle of the ovules (figs. 36 and 37).

In some cases the irritation produced by the growing pollen tube through the tissue of the style, produces profound changes even before it reaches the egg cell and empties its contents. It has been observed, for instance in orchids, that at the time of pollination the ovules are in a very rudimentary condition and await the stimulus of the growing pollen tube, to develop the egg apparatus and prepare for fertilization. A month after the pollen tube starts its growth, the egg apparatus is completed and not until five weeks after this is fertilization completed. Similar phenomena have been observed in mullein, etc. It must not be thought that fecundation always requires so much time for its consummation, on the contrary it is usually a very quick process, requiring only a few days at most in flowering plants and much less in lower plants where the contact is direct.

Strasburger's Observations on the Immediate Process of Fecundation.—On reaching the embryo sac, the pollen tube hardly proceeds as we would expect. It does not penetrate into the egg cell and then burst leaving a free passage for the generative nucleus. In most cases, at least, it does not even penetrate the embryo sac but the end of the tube spreads out over the

apex of the embryo sac, covering the synergidæ (fig. 37). In some of the lower plants as *Peronospora* where the antheridium develops a conjugating tube, a direct passage is said to be formed by the bursting of the end of the tube which penetrates through the wall of the egg cell (fig. 59). The further process in flowering plants is, acccording to Strasburger, as follows: The nucleus of the generative cell of the pollen grain passes into the pollen tube and just before fertilization may be seen in the apex of the pollen tube surrounded by protoplasm. Before fertilization takes place this generative nucleus divides into two nuclei (figs. 41 and 42) and one of these passes out through the mucilaginous apex of the pollen tube and travels between the disorganized synergidæ to the oosphere. The generative nucleus then enters the oosphere, leaving behind it the protoplasm which had served as a vehicle, and fuses with the female pronucleus. Thus fecundation is completed and is as we see by this outlined process, a fusion of nuclei which would support the view that in reproduction the nuclei are the all important organs. The above description does not consider the exisience of attractive spheres in the vegetable cell and as stated in our consideration of cell division, *Guignard*, followed by others, has lately asserted their universal occurrence accompanying the cell nucleus.

Guignard's Discoveries.[1]—After its introduction into the pollen tube the generative nucleus is fusiform and surrounded by a layer of differentiated protoplasm. The directive spheres, two in number, are generally found at one end of the nucleus. When the generative nucleus divides into two, as explained above, after it has passed into the pollen tube and is located near the apex, the longer axes of the nuclear spindle, is always parallel to that of the pollen tube, hence that one of the resulting reproductive nuclei which is nearest the end of the tube has its attractive spheres preceding it. While the other on the contrary presents them behind the nucleus, where the other pole was situated. *Thus at the moment when the first of these cells, which alone is charged with fecundation, penetrates into*

[1]Guignard, "Sur la Nature Morphologique du Phènomené de la Fécondation." Compt. Rend. de Biol. 9 Ser. T. III (1891) p. 467.—Annal. des Sci. Nat. Bot. l. c.

the female apparatus the two directive spheres which it possesses precede it.

In the embryo sac, as explained above, one stage shows the nuclei disposed in two tetrads, one at the summit and the other at the base. In the apical tetrad the nuclei which belong to the synergidæ are formed by a horizontal division (figs. 43 and 44) and their attractive spheres, therefore, occupy their lateral faces. The two other nuclei on the contrary are originated in a perpendicular plane (fig. 43). Thus the nucleus which goes to form the oosphere, has its two attractive spheres above it (figs. 44 and 45, *b*) while the other that travels to the centre of the embryo sac to fuse with a similar one from below, has its attractive spheres below it. (Upper nucleus, fig. 44, *c*.

The male nucleus, which is strongly contracted in its passage into the egg cell, increases in size and forms what is now termed the male pronucleus which is preceded, it will be remembered, by its two attractive spheres (fig. 45, *d*). The contact first occurs between the attractive spheres. These coalesce two by two, male sphere with female sphere (fig. 46). They then separate from each other so as to allow the male and female pronuclei to pass between them and fuse (fig. 47 and 48). The male pronucleus unites with the female pronucleus and remains thus in contact but is clearly distinguishable until the first segmentation starts. In each couple, formed by the union of male and female attractive spheres, the fusion takes place slowly. When thoroughly fused fecundation is complete. The two new spheres thus formed will be the origin of the poles of the first segmentation spindle. Before the first division they orient themselves in such a fashion that this spindle will be parallel to the longitudinal axes of the egg cell. *It results, from these observations, that the phenomena of fecundation consists not only in the copulation of two nuclei of different sexual origin but also in the fusion of two protoplasmic bodies of equally different origin.*

The process of fecundation in the sea urchin, explained above from Foll, agrees chiefly with this. Differing only in that the attractive sphere does not divide until it enters the egg.

Polar Globules in Plants.—Have we now anything in the

maturation of the egg cell and the antherozoids that correspond to polar globules in the animal egg? In short, it is thought that we find analogous exudations of nuclear matter almost universally in plants. In the development of the planogametes of *Ulothrix* a portion of waste protoplasm is extruded with the planogametes containing probably the extruded nuclear matter.

Among the well differentiated female gametes, it is said, *Peronospora* affords an excellent illustration of what we may term polar globules. In the development of the oosphere, according to Wagner, the numerous nuclei which at first are scattered uniformly throughout the oogonium (fig. 57) at length approach the periphery leaving the central portion of the oogonium occupied by large vacuoles, and a small central mass of protoplasm connected with the periphery by protoplasmic strands. The nuclei now limited to the periphery further divide and 2 or 3 (?) finally leave the periphery and approach the central mass of protoplasm traveling along the connecting protoplasmic strands and supposedly unite in the centre, forming the nucleus of the oosphere (fig. 58). While these nuclei are thus traveling toward the centre, the cell wall of the oosphere begins to form, separating the central mass of protoplasm with its two nuclei from the peripheral or *periplasm* with its numerous nuclei, some of which are supposed to be used up in the formation of the oosphere wall. The nuclei thus relegated to the periplasm have been considered as of the nature of polar globules. But with the present light on the subject it must remain surely as a very doubtful and indefinite case.

In the development of the antherozoöids of ferns, when the antherozoöid is set free there is attached to its posterior end an appendage which is usually described as a protoplasmic vesicle, but Dodel-Port and Belajeff think it to contain nuclear matter also from the mother cells.

In flowering plants the nucleus of the pollen divides into two cells (figs. 39 and 40) a vegetative and a generative. The vegetative is thought by Strasburger to have the function of a polar globule. Again the generative

nucleus after it has passed down the pollen tube divides, and only one portion enters the oosphere (figs. 41 and 42), the other remaining as waste nuclear matter and may be considered as a second polar globule. In the development of the embryo sac it is thought the division of the nucleus which gives rise to the nucleus of the egg cell and of the polar nucleus which travels to the middle of the embryo sac to fuse with a similar one from the basal tetrad, is one of the divisions sought and that the polar nucleus has in reality the significance of a polar globule. If a second polar globule is formed it is likely the preceding division, that which gives rise to the first of the synergidæ. If this is the case the regular after division that forms the two synergidæ may be looked upon as corresponding with the rather abnormal but quite frequent division which occurs in the first polar globule of many animals.

The instances cited of polar globules in the vegetable kingdom, it will be seen, do not possess that definiteness that is found in the animal kingdom. We fain would have greater definiteness but further work is here necessary. Doubt clusters about many questions connected with fertilization. We must be content to take things as they are even if somewhat unsatisfactory, until further investigation throws light on the obscure points.

Shaw School of Botany.
December 16, 1891. St. Louis, Mo.

EXPLANATION OF PLATES.

The figures are mostly redrawn or adapted from various standard investigations. A few are original.

PLATES XI–XIV.

Fig. 1. A portion of the frond of *Caulerpa*, natural size. (Redrawn from Sachs.' Phys. of Plants, Eng. Ed. p. 492.

Figs. 2–9. *Iris pumila.* Dividing mother cell of a stoma. (Redrawn from Strasburger "Zellbild. und Zellteil." (3rd. Ed. 1880.) Pl. viii). Fig. 2. Resting nucleus. 3. Contraction and breaking up of the nuclear thread. 4. Nuclear spindle. 5.

Separation of chromatin segments. 6. Fusion of chromatin segments at each pole.. 7 and 8. Organization of the daughter nuclei and formation of the cell plate. 9. The two resulting daughter nuclei.

Figs. 10–11. (Redrawn from Watase.—"Karyokenesis" Biological Lectures p. 168). Fig. 10. Nucleus dividing, showing archoplasmic spheres; (*a*) centre of archoplasm; (*c*) cytoplasm. Fig. 11. Division of the archoplasmic sphere.

Fig. 12. (Original). Diagramatic outline of nuclear division modeled from Guignard's description; (*a*) centrosome surrounded by a hyaline circle; (*b*) surrounding granular circle; (*c*) cytoplasm.

Fig. 13. (Original). Diagramatic outline of the development of the *Acrasieæ*; (*a*) spore; (*b*) escaping mass of protoplasm; (*c*) swarm spore; (*d*) swarm spore preparing for division; (*e*) dividing swarm spore; (*f*) completion of the division; (*g*) plasmodium; (*h*) sporangium.

Fig. 14. (Original). Diagramatic outline of the plasmodium formation, etc. in *Myxomycetes*; (*a*) swarm spores; (*b*) starting of fusion; (*c*) plasmodium; (*d*) sporangium.

Figs. 15–16. (Redrawn from Strasburger Bot. Zeit. xxxv, (1877) Taf. xiii, fig. 14, f. and i.) Multiple conjugation of the zoospores of *Acetabularia mediterranea.*

Fig. 17. (Redrawn from Dodel-Port in Vines. Phys. Bot. p. 606) Planogametes of *Ulothrix*, one free, others in conjugation.

Fig. 18. (Redrawn from Strasburger) Reproduction of a moss plant; (*a*) archegonium with enclosed egg cell; (*b*) antherozoöid.

Fig. 19. (Redrawn after Berthold in Binet's Psychic Life of Micro-Organisms p. 84) Planogametes of *Ectocarpus siliculosus.* (*a–c*) Differentiation of female planogamete; (*d*) female planogamete surrounded by males; (*e–h*) process of conjugation.

Fig. 20. (Adapted from Geddes and Thomson in Evolution of Sex.) Diagram of the course of development of fecundation. (*a*) Adhesion of swarm spores into plasmodium, ex. *Acrasieæ*; (*b*) fusion of swarm spores into plasmodium, ex. *Myxomycetes*; (*c*) multiple conjugation of planogametes, ex. *Acetabularia*; (*d*) conjugation of two planogametes, ex. *Ulothrix*; (*e*) conjugation of dimorphic notile cells, ex. *Cutleria*; (*f*)

fecundation proper of egg cell by antherozoöid, ex. *Moss Plant.*

Fig. 21. (Redrawn from Thuret in Bessey's Bot. p. 267). Oosphere of *Fucus vesiculosus* surrounded by spermatozoids.

Fig. 22. (Adapted from Schmitz Ann. and Mag. of Nat. Hist. vol. xiii, Ser. 5, (1884) Pl. 1, figs. 16–19) *Dudresnaya purpurifera.* (*a*) Trichogyne with adhering spermatia; (*b*) egg cell; (*c*) conjugating cell cut off at end of ooblastema filament; (*d*) auxiliary cell; (*e*) later stage after conjugation of auxiliary cell and ooblastema filament.

Fig. 23. (Adapted from Schmitz, l. c.) *Glœosiphonia capillaris,* (letters as in fig. 22.)

Figs. 24–29. Redrawn from Foll, Comptes Rendus l. c.) Fecundation of the egg of the sea urchin.

Figs. 30–35. (Redrawn from Strasburger, Zellbild, und Zellteil, 3 Anflage, Pls. iv and v). Development of the embryo sac and egg apparatus of *Monotropa hypopitys.* Fig. 30. Nucellus with embryo sac; and (*a*) its primary embryo sac nucleus. Fig. 31–34, enlargement of embryo sac and formation of the two apical tetrads of nuclei. Fig. 35. (*a*) synergidæ; (*b*) egg cell; (*c*) the two nuclei, one from each tetrad that fuse forming the nucleus proper of the embryo sac; (*d*) antipodal cells.

Fig. 36. (Original). Camera sketch of a longitudinal section of the pistil of *Yucca angustifolia,* x. about 5 diam. Showing the continuous styler tube with numerous pollen tubes running down to the ovules.

Fig. 37. (Original). Camera sketch, x. 400 diam. of the ovule of *Yucca angustifolia,* showing one ovule coat, the nucellus, the embryo sac with its enclosed egg apparatus, and a pollen tube; (*e*) that has entered the micropyle of the ovule and penetrated to the embryo sac.

Fig. 38. (Original). Conducting tissue. Cross section of the style of *Yucca augustifolia.* Camera sketch, x. 150 diam.

Figs. 39–42. (Redrawn from Strasburger Befrucht. bei den Phaner. Taf. 1.) Fig. 39. Young pollen grain during division into generative and vegetative cells. Fig. 10. Mature pollen grain; (*a*) vegetative nucleus; (*b*) generative nucleus. Figs. 41 and 42. Portions of the pollen tube with the generative nucleus in division.

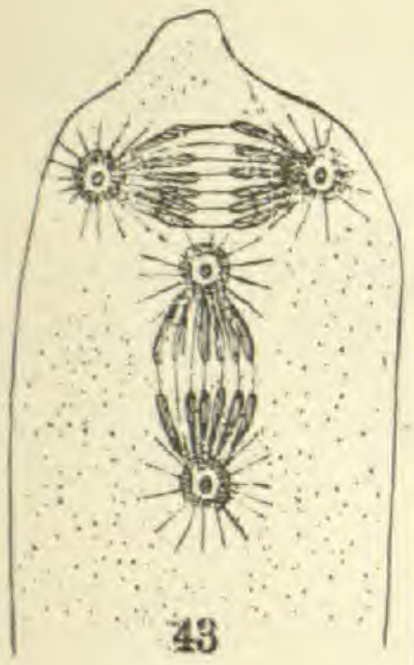
Figs. 43–48. (Original). Diagramatic outlines of embryo sac and nuclear changes during fecundation modeled from Guignard's descriptions. Fig. 43. Division of nuclei to form the upper tetrad, showing asters centrosomes, etc. Fig. 44. (*a*) synergidæ; (*b*) oosphere; (*c*) union of nuclei to form the nucleus of the embryo sac. Fig. 45. (*a*) nuclei of the synergidæ; (*b*) nucleus of the oosphere; (*d*) male pronucleus preceded by its directive spheres; (*e*) pollen tube. Fig 46. Union of the male and female directive spheres. Fig. 47. Separation of the directive spheres and union of nuclei. Fig. 48. Fecundated nucleus ready for the first segmentation, the male portion is still distinguishable (the male nucleus in the last three colored dark).

Figs. 49–56. (Redrawn from Guignard, Annal. des Sci. Nat. Bot. Se. 7, T. xiv, Pl. 10). Formation of the pollen grains in a pollen mother cell of *Lilium martagon.* Fig. 49. Mother cell in resting stage showing chromatin band, nucleolus (paranucleolus) and two directive spheres. Fig. 50. Rupture of chromatin filament into 12 segments. Fig. 51. Division (longitudinal) of these segments. Fig. 52. The nuclear spindle in profile. Fig. 53. Separation of the daughter segments and division of the directive sphere. Fig. 54. Two cells in the resting stage, completion of the first division. Fig. 55. Division of these two cells to form the four pollen grains. Fig. 56. One of the young pollen grains of the last division in a resting stage before the division which gives rise to the vegetative and generative nuclei. (See Fig. 39.)

Figs. 57–59. (Redrawn from Wagner, Ann. of Bot. vol. iv, Pl. vi.) Fecundation of *Peronospora parasitica.* Fig. 57. Oogonium with antheridium at one side. Fig. 58. Formation of oosphere, two nuclei approaching the centre to unite. Fig. 59. Mature oosphere in process of fecundation, showing the antheridial tube grown through the oogonium to the oosphere.

Fig. 60. (Adapted from Geddes and Thomson, l. c.) Diagram illustrating effect of environment on an amœboid cell. On the left, when subjected to preponderating katabolism, *yielding antherozoöid.* On the right when subjected to preponderating anabolism, yielding oosphere. Medium conditions indicated by the central line of amœboid cells.

PLATE XIII.



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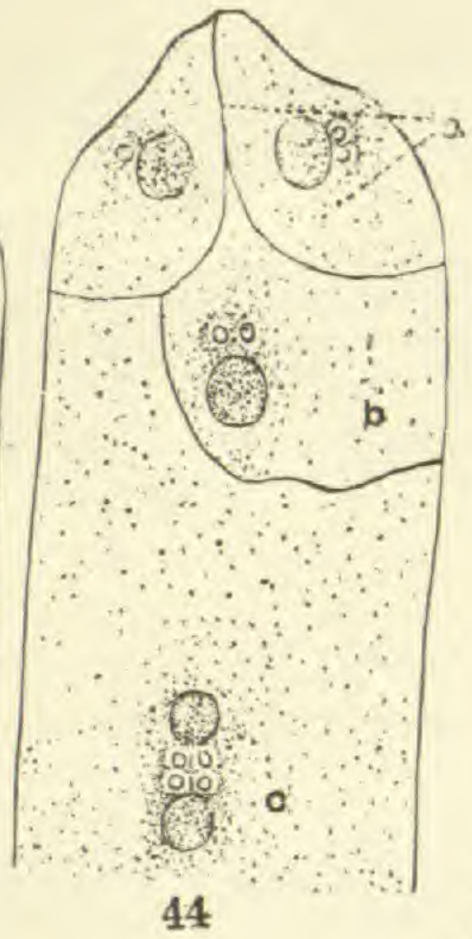

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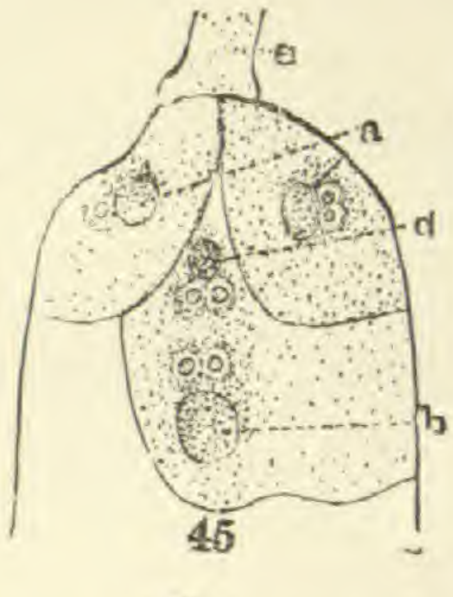

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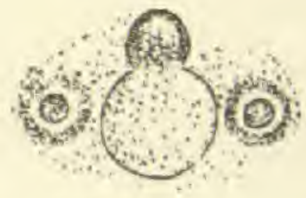

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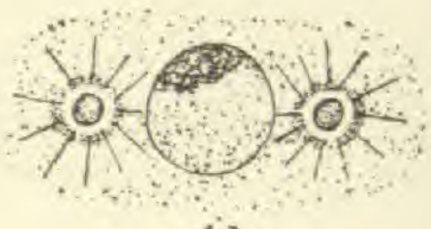

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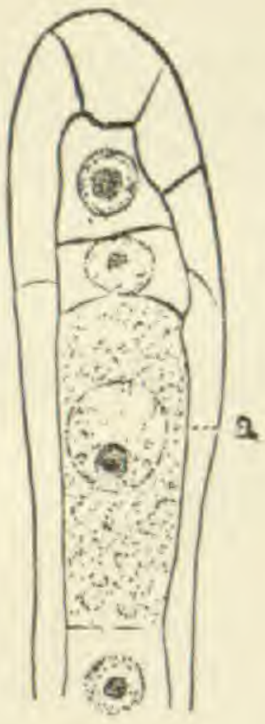

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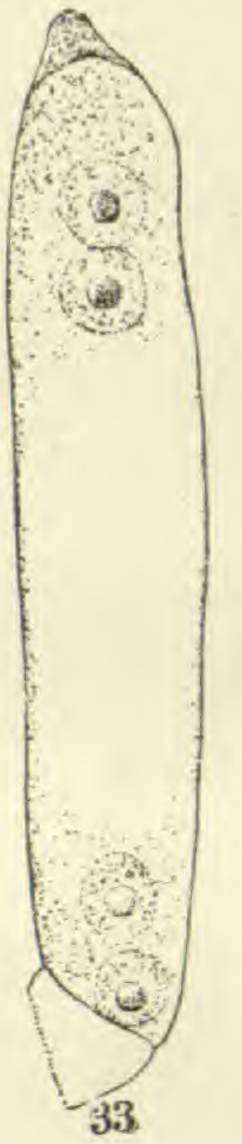

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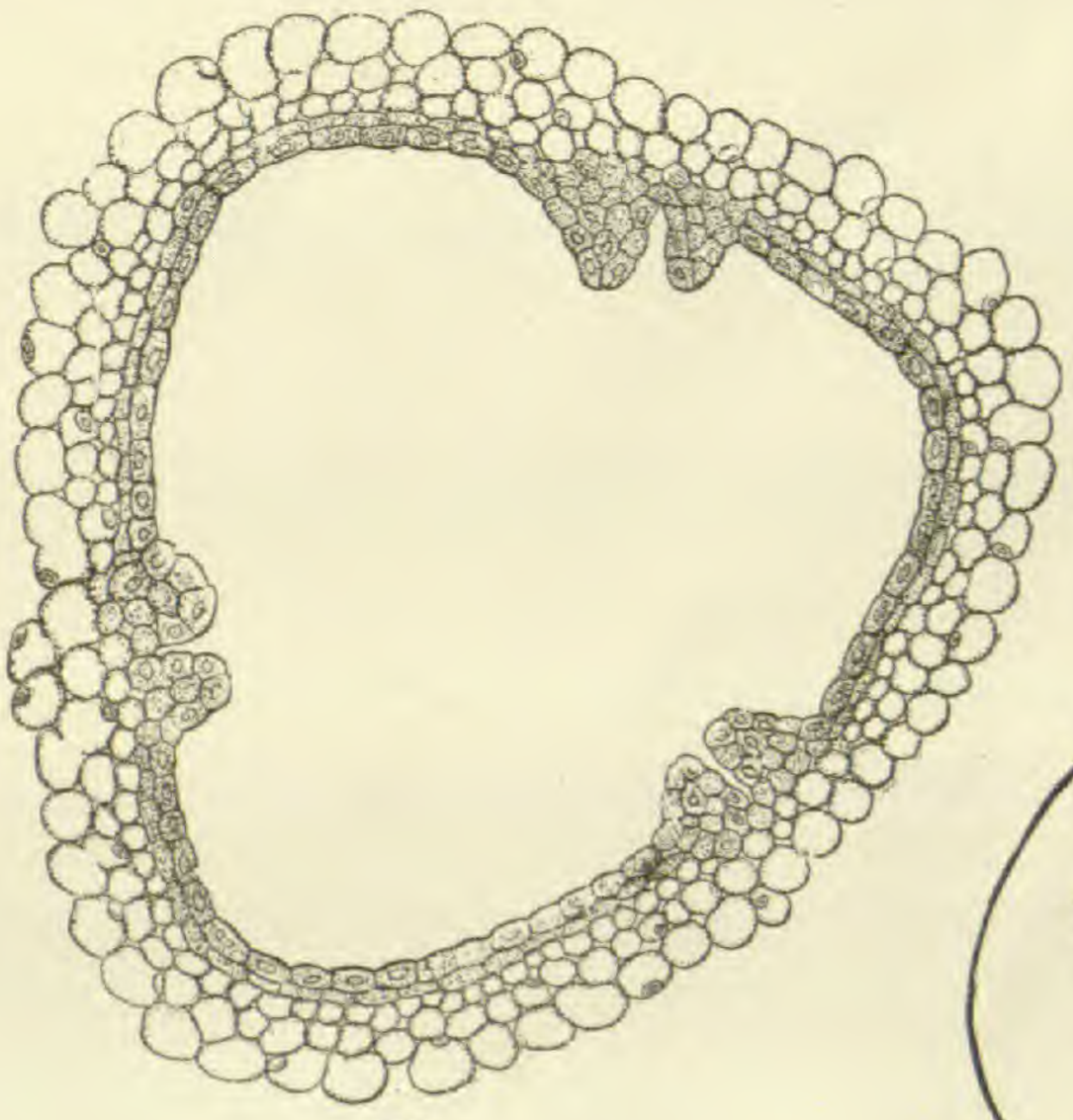

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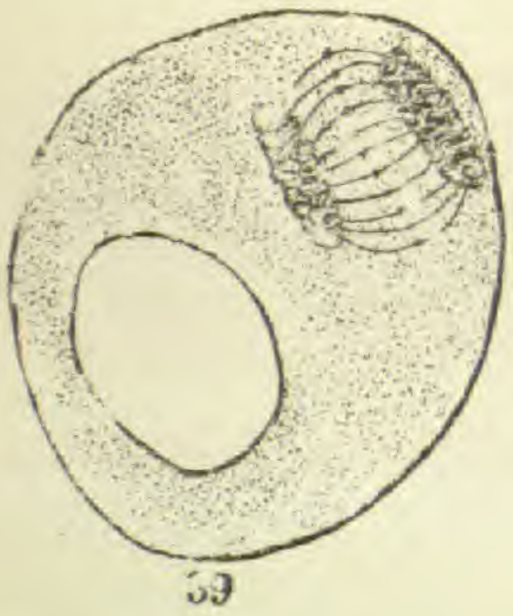

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Fecundation and Development.

RECORD OF NORTH AMERICAN ZOOLOGY.

BY J. S. KINGSLEY.

(Continued from Vol. XXV., page 989.)

ARTHROPODA.

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——The reproductive organs and early stages of the development of the American lobster. J. H. U. Circ., X., p. 98, 1891.

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EDITORIALS.

EDITORS, E. D. COPE AND J. S. KINGSLEY.

—It is to be hoped that the alleged intention of the Postmaster-General to unify the system of names of post-offices in the United States may be carried into effect. The poverty of inventive capacity of our people in the matter of the giving of names is remarkable. Many places in the Eastern States are named from localities in the Old World, from which the early immigrants came. This is objectionable, but it is tolerable so long as the duplication shall go no farther. Such naming as was practiced by the early inhabitants of the State of New York was less excusable, since no bond of local affection was the motive for ransacking the ancient geographies and dumping their contents broadcast over the wilderness. But now we meet with duplication after duplication springing up in all the States, south and west of the Alleghanies. The settlers and builders of new towns seem to imagine that to give a name which is not already on the map or in a book reflects on their intelligence and knowledge of geography; so that new Manchesters, Birminghams, Troys, Romes, Athenses, Springfields, etc., etc., are springing up with a rapidity that is confusing to the mind and destructive to any correct knowledge of the whereabouts of such places. A little reflection will convince any persons desirous of naming a new town or post-office that one of the most efficient ways of advertising a place is to give it a name unlike any other; and moreover that by so doing much trouble in the matter of future mail delivery will be spared them.

A majority of our naturalists who have naming to do exhibit the same deficiency. They frequently encourage foolish naming of localities by naming species after them. If such local names are changed hereafter the scientific names founded on them will be left high and dry. But the least excusable form of scientific name is that which is taken from a locality whose name is already a duplicate of one in the Old World. Who ever heard of Naples in New York? Yet a paleontologist has recently named an important fossil *Clymenia neapolitana*, which is found in the "Naples shale," in Western New York. Another has with equal absurdity named a species from Minnesota *Camarella bernensis*. A geologist names a glacial beach the Leipsic

beach. There should, of course, be no such names as Naples, Berne or Leipsic in America; but as they are there, it is a conspicuous gaucherie that scientists should seek to preserve them in nomenclature. Science is cosmopolitan, and the law of priority should apply to local names as well as to anything else. It is to be hoped that the time will come when a rule will be added to those in our code, that no name shall be given from a locality whose name had a previous existence in some other part of the world.

—We have received a circular from a distinguished member of National Academy of Sciences which suggests that the number of members of the Academy be reduced to seventy. The number of one hundred does not seem to be excessive if we consider the probable future of our country, but an increase in the number is clearly inadvisable. The proposed reduction seems to us equally so. The change most needed is one which shall designate classes of members and thus keep deficiencies more clearly before the Academy. Four classes were proposed several years ago, with the following proportions: Of the 100, 35 to represent inorganic science (Sec. A); 35 to represent organic science (Sec. B); 15 to represent mental and mathematical science (Sec. C); and 15 to represent applied science (Sec. D).

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RECENT LITERATURE.

Some Recent Zoological Text-books.—In the last few years German zoologists have produced a considerable number of handbooks, manuals and compendiums of zoology and its various subdivisions, the majority of which have been issued from a single publishing house, that of Fischer of Jena. The first requiring mention is the zoology[1] by Boas of Copenhagen. This is in reality a second edition of the Danish work of 1888, and the author acknowledges the assistance received from Prof. Spengel in making the translation. It differs from the original in many respects, the most noticeable being an added section, entitled "Biologie." The work is divided into two portions, general and special, occupying respectively 90 and 475 pages. In the first occur those general statements regarding cells, tissues and organs, the relation of animals to their environment, and the outlines of the theory of evolution; which are deemed indispensable in the ordinary text-book. In the special portion the various groups of the animal kingdom are discussed. As must occur in a work by a single author there is considerable inequality in the treatment, while a rather reprehensible practice (not however confined to Dr. Boas) of treating certain groups as appendages (Anhangen) of others result in some rather queer associations. To show the scope and views of the author, an outline of the classification followed is here given. 1, Protozoa; 2, Cœlenterates, with the sponges as an anhang; 3, Echinodermata; 4, Plathelminthes (including Nemertines) with the Rotifers as an anhang; 5, Nemathelminthes; 6, Annelida, with the Gephyræa as an anhang to the Chætopods and separating them from the Hirudinei, and with Polyzoa and Brachiopods as an anhang to the whole group; 7, Arthropoda divided into Crustacea, Myriapods, Insecta and Arachnids; Limulus being inserted between Cladocera and Ostracoda, the Stomatopoda following the Decapods; and Peripatus serving as an anhang to the Myriapods; 8, Mollusca, arranged as follows: Chitons, Gastropoda, Acephala, and Cephalopoda, the Pteropoda being closely associated with the Opisthobranchs; 9, Vertebrata, divided into Leptocardii, Pisces, Amphibia, Reptilia, Aves, and Mammals, while the Tunicata occupy the last four pages of the volume of the work, as an appendix to the Vertebrates. The work of Boas, as a

[1]Lehrbuch der Zoologie für Studirende und Lehrer, Dr. J. E. V. Boas, Jena, 1890, pp. 578.

whole seems well adapted to replace the well-known "Lehrbuch" of Claus. It is possibly not so satisfactory in its treatment of the invertebrates, but in the vertebrates, as one would expect from Dr. Boas' reputation, it far surpasses the latter. Its smaller size is distinctly a recommendation in its favor. The illustrations, 378 in number, are largely diagrammatic, but are not very artistic.

The fifth edition of Claus's Lehrbuch[2] has been subjected to only a very cursory examination. The additions (92 pages and 77 cuts) are considerable but they seem to be mostly of minor importance, while the many glaring faults of the previous edition are left unaltered. Possibly a more thorough examination would show that the improvements were commensurate with the increase in size.

It is greatly to be regretted that the zoology of Hatschek[3] show but slight chance of completion, for while the work is scarcely adapted for the students of the grade of those in our colleges, it is certainly so far as it goes, most suggestive to the more advanced morphologist. That very wealth of theory, which spoils the work for the beginner, opens up new vistas to his instructor. Yet, if it never be completed, it will long have its value for the student, just as has the still uncompleted vertebrate volume of the Handbuch der Zootomie of Stannius. An analysis of the work is next to impossible in its uncompleted condition.

One familiar with Schmidt's small Comparative Anatomy would never recognize it in Lang's new edition,[4] in which, to our minds all reference to the previous editions should be omitted. The two parts which have already appeared discuss those groups which are usually included under Protozoa, Cœlenlerates, Worms, and Arthropods; and here as in Hatschek's work, the subject is allowed to logically develop itself, there being no distinction between general and special portions. Thus in Lang's work there are first a few words upon the cell and then the account of the unicellular animals, the tissues and organs of the many-celled forms being described and elucidated later as the occasion demands. Between Hatschek's and Lang's works there are

[2]C. Claus. Lehrbuch der Zoologie. 5 Aufl. Marburg, 1890, pp. xii, 958, xx.

[3]Lehrbuch der Zoologie, eine morphologische Übersicht des Thierreiches zur Einführung in das Studium deiser Wissenschaft von Dr. Berthold Hatschek. Erste bis dritte Lieferungen Jena, 1888-1891, pp. iv, 432.

[4]Lehrbuch der vergleichenden Anatomie zum Gebrauche bei vergleichend anatomischen and zoologischen Vorlesungen von Dr. Arnold Lang. Neunte gänzlich umgearbitete Auflage von Edward Oscar Schmidt's Handbuch der vergleichenden Anatomie. Erste und zweite Abtheilungen. Jena, 1888-1890, pp. iv-566.

many contrasts. Where Hatschek is brilliant, Lang is conservative; Hatschek gives generalizations; Lang offers a mine of detail; Hatschek has many novelties in classification; Lang follows rather the beaten track. In short Lang's work stands to-day the most useful compendium of invertebrate anatomy in existence. When the other portions are finished (which we learn from the author will be in about two years) the whole will take a front rank among the text-books of the world.

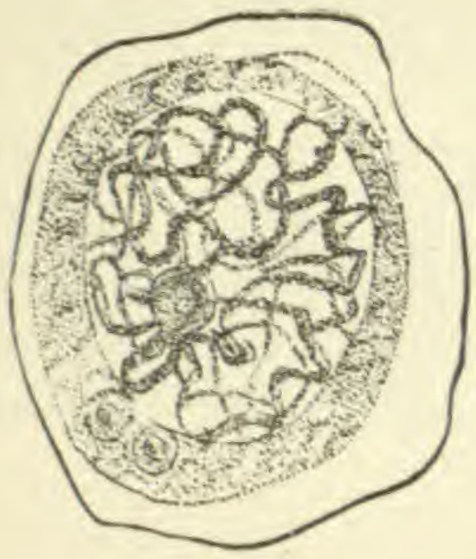
Another work of somewhat different scope which deserves praise as high as Lang's Anatomie, is the Comparative Embryology of the Invertebrates[5] of Korschelt and Heider, of which two parts have already appeared. In opening a work of this character one naturally compares it with the classic work of Balfour, issued ten years ago. Until the whole work is completed a satisfactory comparison cannot be made, for while Balfour scattered many of his generalizations through the accounts of the different groups, the young Berliners reserve more for the special portion which has yet to appear. It is interesting to compare the size of the two volumes in some detail as follows, keeping in mind the fact that the page of Korschelt and Heider contains about 25 per cent more than that of Balfour.

	Balfour.	Korschelt & Heider.
Sponges.....	12 pages.	18 pages.
Cœlenterates	31 "	84 "
Annelids.....	38 "	65 "
Other "worms".....	47 "	80 "
Enteropneusti	4 "	11 "
Echinoderms	31 "	50 "
Arthropoda.....137	"	600 "

This conveys some idea of the amount of literature which has been boiled down into these two parts, for they must be regarded rather as compilations than as philosophical works; the philosophy is to come later. We learn that the concluding part will include the Molluscs, the Tunicates, Balanoglossus and Amphioxus, in other words all that are not in the strictest sense vertebrates; as well as the general portion, and that a year or two more must elapse before the whole is completed. Thus it, together with the somewhat older Lehrbuch der Entwick-

[5]Lehrbuch der vergleichenden Entwicklungsgeschechte der wirbellosen Thiere von Dr. E. Korschelt and Dr. K. Heider. Specieller Theil. Erstes und zweites heften. Jena, 1890–91, pp. xii–908.

PLATE XIV.



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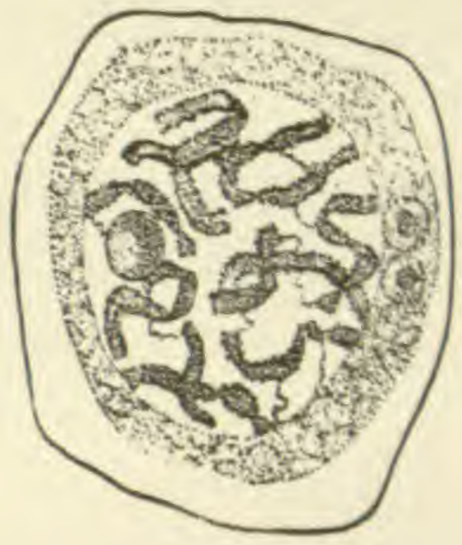

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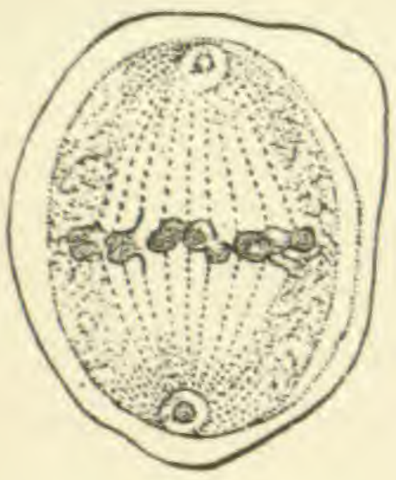

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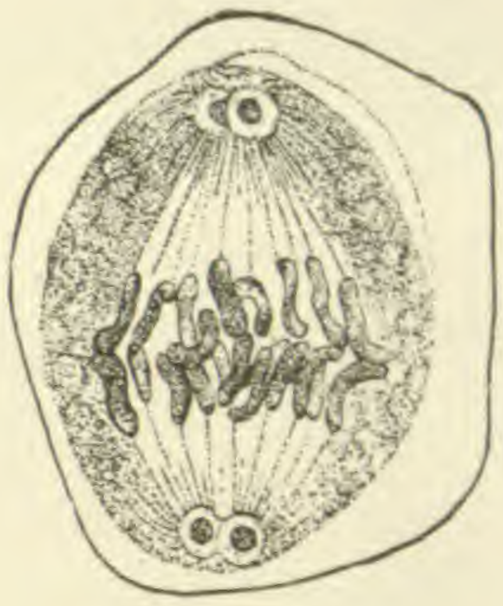

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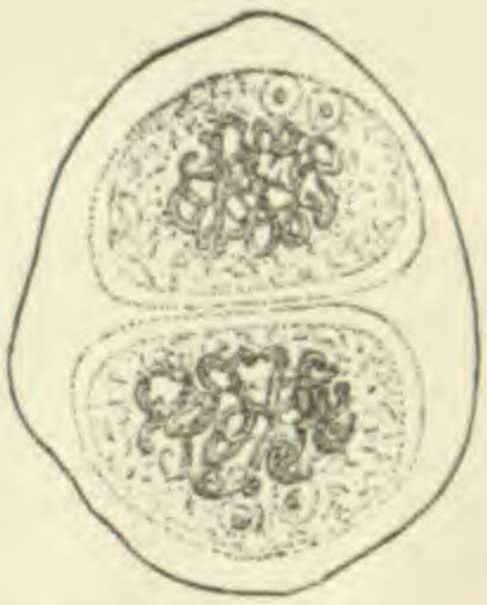

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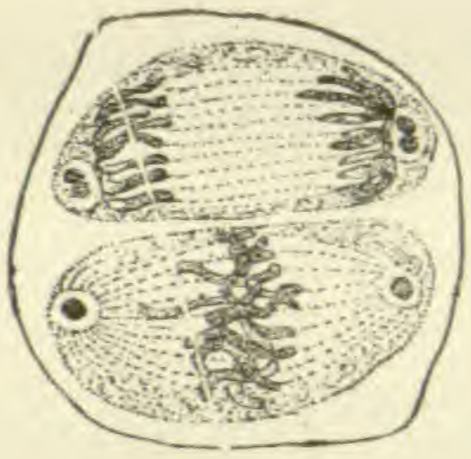

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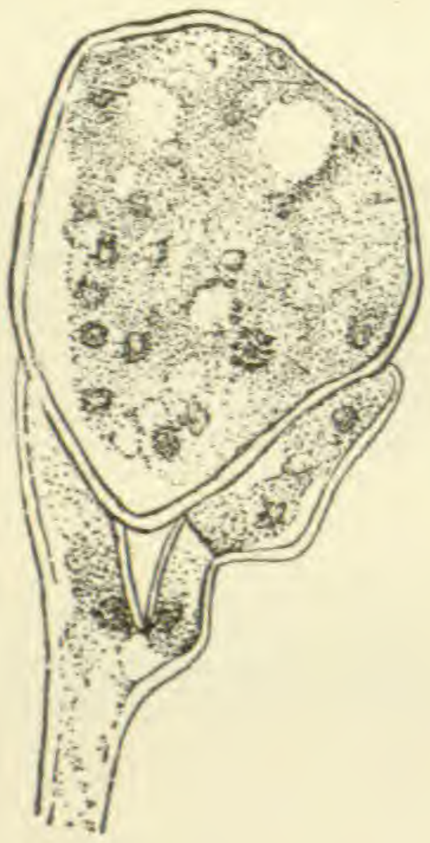

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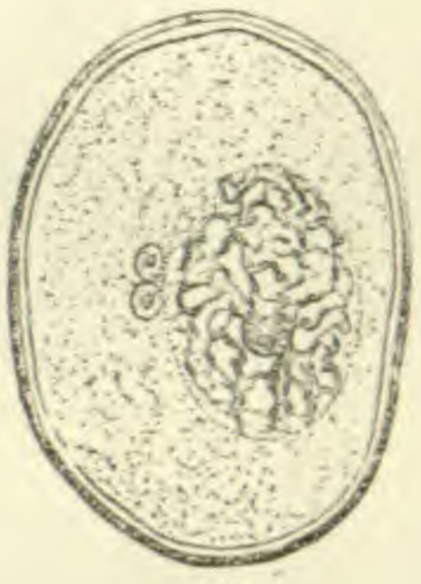

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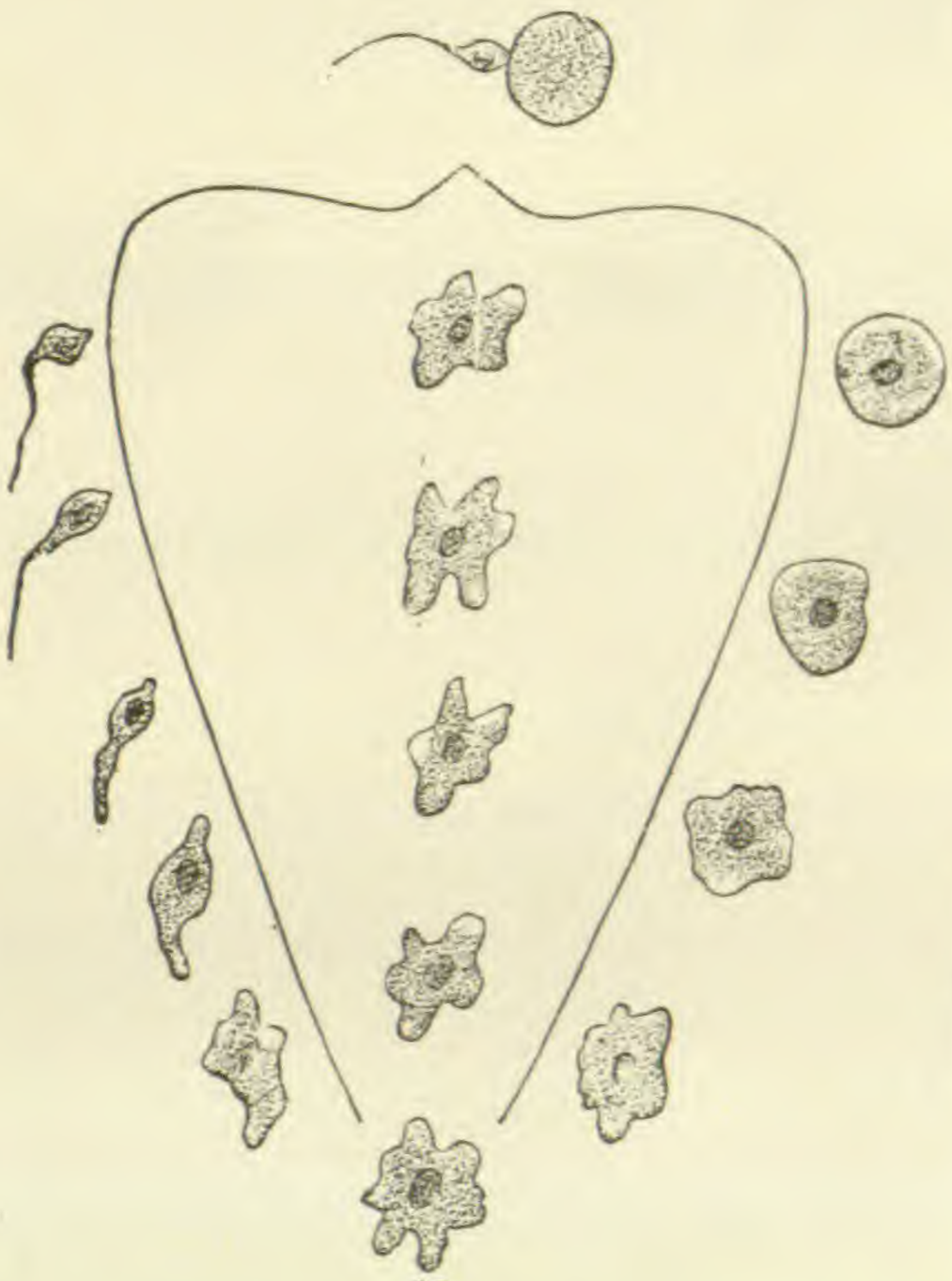

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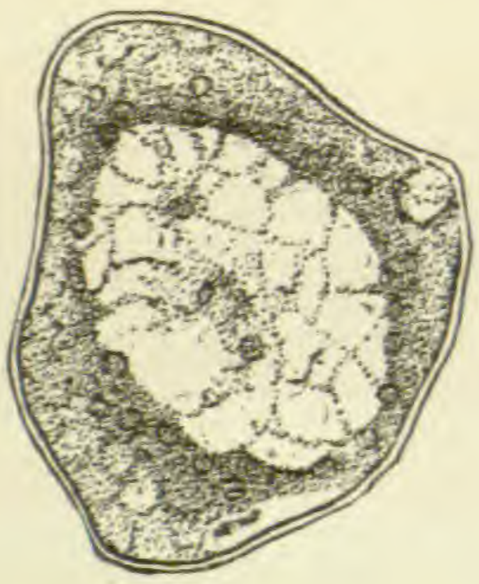

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Fecundation and Development.

lungsgeschichte of Oscar Hertwig, will form a compendious account of Embryology as it is understood to-day.

Last in our series comes the Zoology[6] of Richard Hertwig, of which the second and concluding portion is promised immediately. From the reputation of the author and from the compact size of the volume we had hoped for much in this work, but to us it seems far less satisfactory than any of the other works enumerated. All of the others bear abundant evidence of careful preparation but this shows on every page haste and carelessness. This shows itself not only in matter but in typographic arrangement. Thus the chapter on the Development of Systematic Zoology is made of equal rank to the section headed "History of Zoology." On the textual side adverse criticism is easy. Thus the account of the theory of evolution, though nearly thirty pages in length, contains no mention of the post Darwinian labors. Ten pages are devoted to the cell and cell division but no mention is made of the part played by the centrosome. The account of coral formation (p. 210) is unintelligible and misleading. The Narcomedusæ are ignored. A lack of proportion is everywhere noticeable. Thus the Protozoa have 33 pages accorded them, while the Annelids have but 12. These are but samples. The book, on the other hand has its good features. We have been pleased with the concluding portions of each section, entitled "Zusammenfassung der Resultate," where in categorical form the author has brought together in condensed shape the most important facts regarding the group, and which might almost be used for a syllabus of lectures.

The text-books which have been mentioned are all in German, but two of them are announced for English translation—Korschelt and Heider's Embryology and that of Oscar Hertwig, while a portion of Lang's Anatomy has already been issued. With this German zoological vitality the English language offers nothing in comparison. No text-book has been issued from England or America in the last five years and the long advertised zoology by an English zoologist will hardly appear for five years to come. But Germany still puts out new books and new editions. In the early future we are promised a new Comparative Anatomy by Gegenbaur, new editions of both the "Lehrbuch" and the "Grundriss" of Comparative Anatomy by Wiedersheim, while Prof. Lang of Zürich is contemplating an abridgement of his Comparative Anatomy as soon as the larger work is complete. The proposed edition of Balfour's Comparative Embry-

[6]Lehrbuch der Zoologie von Dr. Richard Hertwig, Erste Theil. Jena, 1891, pp. 320.

ology revised to date is abandoned for the present, while a new work on the Embryology of the Vertebrates, by Dr. C. S. Minot will appear at an early date.—J. S. KINGSLEY.

Stanislas Meunier's[7] "**Les Methodes de Synthèse eu Minéralogie**" is a monumental work worthy alike of the author who wrote it and of the subject of which it treats. Nearly all books on the artificial production of minerals that have heretofore appeared have been simply lists of products obtained in the laboratory, classified under the titles of the natural products with which they are identical. In the present volume a notable improvement has been made in the method of presenting that most fascinating of all mineralogical problems—the manufacture of minerals and the bearing of the processes involved therein upon the great geological questions relating to metamorphism, the production of mineral veins and the formation of ores. Instead of briefly mentioning the different methods by which the several minerals have been obtained, the author discusses the methods themselves, and illustrates them by citing the many products which each yields. He then points out the manner in which the processes throw light on the origin of mineral names in the earth's crust, and shows the relations existing between them. The study of chemical geology must receive a new impetus if the volume before us is made of as much use as it deserves to be. Geologists will thank the author for the suggestive hints that are so abundant throughout his book; mineralogists will welcome the appearance of a volume that so clearly describes the processes by which so many interesting minerals have been manufactured; chemists, if they will only think so, may find given in the treatise many reactions that will help to clear up the difficult problem of the constitution of inorganic compounds, and so will join with the mineralogists and the geologists in according the work a hearty reception.

The historical method of development of the subject is followed in most instances. After classifying the methods that have been employed by the many workers in this field, Meunier begins by giving a very detailed account of the different processes as they were first used, and then mentions their modifications, in each case referring briefly, or at length, as occasion demands, to the minerals yielded by each. Before taking up the subject proper of the work, the author describes the conditions under which minerals are being formed at

[7]Paris, Baudry et Cie, 1891, pp. xii and 359.

present in various portions of the earth, and follows these with an account of the accidental syntheses that have been reported, such as those resulting during the burning of coal under ground, or those produced by action of the moisture of the soil upon coins buried in it, etc. He then comes to the subject proper of the book—an account of the 'rational syntheses' that have been made. He gives an account of all the minerals formed by dry fusion, with or without the intervention of a 'mineralizer,' describes the wet methods that have yielded products identical with minerals, and discusses the mixed processes that have given similar results. The classification of methods is simple and at the same time satisfactory. So far as the reviewer is able to judge, nearly all mineral syntheses that have ever been made are at least referred to in Meunier's book.—W. S. BAYLEY.

The Worms of Bronn's Thier-Reichs.—This volume was commenced by A. Pagenstecher who wrote "Lieferungen 1–6" and was then obliged to give up further work on account of ill-health. Prof. Max Braun[8] of Königsburg (i, Pr.), Germany has undertaken the task of completing the treatise and up to date has issued Lief. 7–16.

Lief. 1–7 are given up to a historical introduction (261 p.), while the remainder of the work which has thus far appeared is occupied with a discussion of the Mionelminthes and Monogenea.

The system thus far adopted is:

MIONELMINTHES: I. Rhombozoa, 1. ord. Heterocyemida (genera *Conocyema*, *Microcyema*), 2. ord. *Dicyemida* (genera *Dicyema*, *Dicyemennea*). II. Orthonectida (g. *Rhopalura*). *Trichoplax.*

PLATHELMINTHES: I. Trematodes, 1. Monogenea; families: Temnocephaleæ, 1 genus; Tristomeæ, 3 sub-families with 14 genera; Polystomeæ, 4 sub-families with 18 genera. (It will be noticed that Braun does not use the ending *idæ* determined upon by the International Congress as the ending of the family name).

The work is well written, finely illustrated and contains a very full bibliography with short reviews of every paper. This book will be the most complete treatise in existence on the group Vermes, and is indispensible to those who wish to work in that subject. The Reviewer urges all Americans who publish on the group, to aid Prof. Braun in the rest of his work by forwarding to him reprints of all the papers they publish in this line.

The monograph costs 1 mark 50 pro Lieferung, and is published by C. P. Winter, Leipzig and Heidelberg.—C. W. STILES.

[8]Braun's Klassen und Ordnungen des Thier-Reichs: Bd. iv. Vermes.

General Notes.

GEOLOGY AND PALEONTOLOGY.

The Eocene of the United States.[1]—The present essay is the fourth of a series devoted to the discussion of the correlations of the formations found in the different parts of the country with one another, and with formations in other countries; and to the discussion of the principles of geologic correlation in the light of American phenomena. Mr. Clark thus describes the scope of the work.

"This essay comprises, first a general discussion of the limitation of the term Eocene as employed in American geology. The two-fold character of the Tertiary (1. Eocene, 2. Neocene) in America is insisted on.

After a somewhat extended review of the literature, in which the various opinions upon disputed points are especially considered, a general study of the Stratigraphical, paleontological, and topographical characteristics of the Eocene in the various portions of the country is undertaken.

The description of the Eocene of the United States falls naturally into the three distinct regions, viz: The Atlantic and Gulf Coast region; the Pacific Coast region, and the interior region.

Following a study of the stratigraphical relations of the Eocene of the Atlantic and Gulf Coast region, an attempt is made to correlate the very diverse formations of this great area. Four provinces are provisionally established (1. New Jersey province, 2. Maryland-Virginia province, 3. Carolina Georgia province, 4. Gulf province,) though fuller knowledge may break down their bounds. The general similarity of the deposits and their fossils to extra-American Eocene is shown, but detailed correlation is not considered feasible.

The meager knowledge of the Pacific Coast Eocene precludes any general discussion of the stratigraphical and paleontological relations of that horizon. The local peculiarities, shown both in fossils and deposits, are referred to, and the close relationship existing between the Eocene and Cretaceous is dwelt upon. Their separation is a matter of some uncertainty with our present information. Certain

[1]Bulletin of the United States Geological Survey, No. 83, 1891. Correlation papers. Eocene. William Bullock Clark.

points of identity with Eocene deposits elsewhere are mentioned. Two groups of strata are recognized, one marine (Tejon group), the other brackish (Puget group).

The remarkable conditions under which the deposits of the Interior region were accumulated and the interesting fauna and flora that they afford are fully discussed in the final division of the essay. The general relations of the fauna and flora of the Eocene of the interior to that of other regions is pointed out, though no attempt is made at a detailed correlation of its various members. The Laramie problem, although more fully presented by Dr. White in his paper upon the Cretaceous, is here referred to, and the facts are given which are said to show that the Laramie is in part Eocene. The conflict between the evidence afforded by animals and plants is stated with the consequent hindrance to satisfactory correlation.

Dr. Clark incidentally to the subject gives a historical discussion of the Laramie formation which he finally excludes from the Eocene series. This discussion is of much interest as showing the growth of opinion based on accumulating evidence. He might have been a little more explicit in his reference to the first determination of the Cretaceous age of the Laramie formation. He says, (p. 114), "Prof. E. D. Cope (Amer. Philos. Soc. Trans. xiv, 186–9, pp. 1–252) raises a doubt concerning the Tertiary age of the entire lignitic series ..... by mentioning *Ischyrosaurus antiquus* Leidy from the 'Great Lignitic' of Nebraska as perhaps of Cretaceous age, and *Hadrosaurus? occidentalis* Leidy from the 'Cretaceous beds of Nebraska,'" etc. There was however more than the "raising of a doubt" expressed in the memoir by Cope thus quoted. He says, p. 98; "..... I instituted an examination of the forms brought by Dr. Hayden from this locality [Nebraska] and first of that most characteristic animal the Ischyrotherium of Leidy. This, as has appeared on the preceding pages I believe to be a reptile allied to Plesiosaurus, a conclusion which *at once establishes Mesozoic age of the bed.* It coincides with the presence of Hadrosaurus in indicating Cretaceous or upper Jurassic age."

We observe with surprise that Dr. Clark does not include the Plistocene in the Cenozoic series. We suppose he would relegate this age to a distinct realm, the so-called Quaternary. But the propriety of such a classification has, in our opinion yet to be shown.

Dr. Clark remarks (p. 16); "the term Eocene which is retained as equivalent to Lower Tertiary, may or may not coincide with the division so designated by European geologists." We would suggest then why adopt the term Eocene at all? One is led to suppose from

this and the paragraph preceding it that the term had been originated by the U. S. Geological Survey. The article then goes on to say; "the attempt at a detailed correlation of American formations with European, so often made in the past on insufficient data, is greatly to be deprecated." This is the language of a stratigrapher, but not of a paleontologist. The correlation of horizons the world over is one of the *raisons d'etre* of the science of geology, and it is chiefly to be accomplished by the aid of paleontology. The paleontologic correlation of the American Wasatch with the French Suessonien for instance is so clear, that some day, in a comprehensive system they may be called by the same name. Various other cases are equally clear. In fact the language quoted is the expression of a chauvinism which has been characteristic of the U. S. Geological Survey, but which we hope it will outgrow. A favorable symptom is the very full consideration given to the work of its predecessors in America, as exhibitep in this able monograph by Prof. Clark.

In conclusion, an alphabetical list of the leading articles upon the Eocene of the United States is presented.

A Florida Lake Basin.—In a recent letter from Gainsville, Florida, Mr. Henry Bomford gives the following description of an interesting phenomenon:

"There is a prairie within three miles of this place that is fifteen miles in length, with an average width of five miles. Twelve years ago it filled with water to a depth of eight to twenty feet, varying according to high and low ground. This water stood undisturbed for this twelve years space of time until last August, when it suddenly disappeared in two days, leaving two small holes of water not exceeding ten acres area, and a few ponds here and there of sizes too insignificant to mention.

"The soil here is principally sand, underlaid at varying depths by very soft sand and limestone. There is some flint at great depths.

"Near the location where the water is thought to have made its exit the country is literally dotted with deep holes, varying from ten to forty feet in depth; the sides are steep and precipitous. These holes are commonly known here as sinks, and are sometimes formed in a single night.

"For days after the escape of the water from this prairie the stench of putrid fish was intolerable. The farmers hauled them off in wagons for fertilizers.

"On the prairie anywhere turtle shells can be seen, with here and

there the skeleton of some unfortunate alligator that has been killed by some marksman or by some stray hunter."—*Scientific American*, April 2, 1892.

Xanthidia.—Mr. E. W. Wetherell reports the occurrence of Xanthidia in the London clays. He has succeeded in isolating these minute fossils, and finds that for the most part they follow two types, easily distinguishable, although there are many minor varieties of each of them. These organisms are often found joined together in pairs, or with five or six individuals massed together.

Their characters are as follows: Shape, lenticular; some specimens far flatter than others, perhaps owing to pressure; spines around the edge and springing obliquely from the flattened sides; or, around the edge only. The length, thickness and number of spines gives rise to the two types. The diameter is about $\frac{1}{10}$ mm. When viewed by transmitted light the body portion is of a distinct green color, marked with black spots. Glycerin shows the whole form better than any other medium.—*Geol. Mag.*, Jan., 1892.

Geological News. Paleozoic.—A microsaurian is reported from the Lancashire Coal field. The fossil comprises the head, abdominal region and base of the tail of a small animal occupying the whole of an elongated split nodule 0.08 m. in length. It has been assigned to Hylonomus by A. Smith Woodward under the name *H. wildii*. Among distinctive specific characters may be enumerated the form and proportions of the mandible and dermal armor. (Geol. Mag., May, 1891.)——Mr. Malcom Laurie has described some Eurypterid remains from the Upper Silurian deposits of the Pentland Hills, Eng., one of which has been made the type of a new genus, *Drepanopterus*. This form is characterized by the great breadth of the carapace, and by the shape of the single limb which has been preserved. The limb is long and narrow, and ends in a slightly expanded sickle-shaped segment. The genus seems to be intermediate between *Eurypterus* and *Stylomerus*. (Proceeds. Roy. Acad., Dec., 1891.)——A new Clymenia has been discovered in the Naples Beds of Western New York. It is described and figured by J. M. Clarke under the name *C. neapolitana!* The genus Clymenia has been considered a horizon-marker of the uppermost Devonian, and its discovery in a lower Upper Devonian in company with *Goniatites intumescens* and representatives of the whole series of European Upper Devonian fauna suggests the idea that the fauna of the Naples Beds may be a condensed time-equivalent of a series highly differentiated in the transatlantic Upper Devonian succession. (Am. Jour. Science, Jan., 1892.)

MINERALOGY AND PETROGRAPHY.[1]

Petrographical News.—Still another attempt to arrive at a just view concerning the chemical relations of eruptive rocks has been made, this time by Lang.[2] Calcium and the alkalies are regarded as the best indicators as to the relationships of the rock masses, and in this respect the new investigation departs widely from older ones, in which the silica was always considered as perhaps the most characteristic of a rock's chemical constituents. After citing a large number of analyses of rocks chosen from carefully examined types of all classes, the author divides rock magmas into four great groups, viz: Those in which the proportion of K_2O present exceeds that of CaO and Na_2O combined, or $K_2O > CaO + Na_2O$, and those in which the proportions of the components correspond to the following formulæ: $Na_2O >$, $CaO + K_2O$, $Na_2O + K_2O > CaO$ and $CaO > K_2O + Na_2O$. Each of these groups is then subdivided into types. In the first group, for instance are two orders in one of which $Na_2O > CaO$, and in the other $CaO > Na_2O$. In the first order fall the Cornwall granites with $CaO : Na_2O : K_2O = 1 : 4 : 14$; the Heidelberg porphyry with an alkali ratio of 1 : 1.5 : 8; the dyke granite type with a ratio of 1 : 3.7 : 6, the granite-rhyolite type with a ratio of 1 : 2 : 4, and the orthophyre type with 1 : 3.8 : 7.3. The second order includes the Hesse granite, syenite and bolsenite, with the respective alkali ratios $CaO : NaO : K_2O = 2 : 1 : 6$, 2.5 : 1 : 4 and 1.9 : 1 : 4.8. The other groups are likewise subdivided into orders, and in each of these are ranged the types. Brief notes accompany the descriptions of each type, and a table giving the percentages of the principal constituents of 247 fresh rocks closes the paper. Some of the relationships brought to light by the author's discussion are so unexpected that it may safely be affirmed that the views put forth in his article will meet with much opposition among petrographers. The granites, for instance, are discovered to occur in different orders, under different groups, the types being often further removed from each other than are normal granite and phonolite.——The new rock iolite, described by Ramsay and Berghell[3] fills the place in Rosenbusch's scheme that was left for the plutonic equivalent of the nephelinites. It is a medium to coarse-grained granular rock forming a large portion of the Mountain Iiwaara in the parish of Kunsamo, Finland.

[1]Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.
[2]Min. u. Petrog. Mitth. xii, p. 199.
[3]Geol. Fören. i. Stockholm Förh. 13, 1391, p. 300.

It consists essentially of nepheline and pyroxene, with iiwaarite (a titaniferous garnet), apatite, sphene and cancrinite. Its structure is allotriomorphically granular, though the pyroxene often possesses one or more crystallographic faces. In the finer grained varieties the garnet is not common, but in the coarse-grained phases of the rock it occurs in large quantity. The pyroxene is zonal, with an almost colorless nucleus, surrounded by six or seven colored zones, in which the extinction is high and the color some shade of green. The mineral occurs either as isolated grains in the nepheline or in little nests of grains in this mineral. Cancrinite is not present in all sections, but in many it is abundant as a decomposition product of nepheline. The relationship of the iolite to nephelinite is shown not only in its possession of a titaniferous garnet, but in its chemical composition as well:

	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	Na_2O	K_2O	P_2O_5	Loss	Total
Iolite.....	42.79	1.70	19.89	4.39	2.33	.41	11.76	1.87	9.31	1.67	1.70	.99	= 98.81
Nephelinite	43.89	1.24	19.25		12.00		10.58	2.81	9.13	1.73	1.39		= 102.02

——In consequence of a recent expedition into the Peninsula of Kola, in Northwestern Russia, the senior[1] of the two authors last mentioned has had an opportunity to make a partial geological examination of this little-known territory. He finds the greater portion of the peninsula to be underlain by gneisses, mica schists and Devonian sedimentary beds. The mountains in the neighborhood of Lake Imandra are composed largely of an eleolite syenite, consisting of an intergrowth of albite and microline, eleolite, aegirine, arfvedsonite, eudialite, ainigmatite and a number of other rare and some new species. The aegirine forms long prisms whose extinction is about 4–5° and whose optical angle exceeds 114°. Sometimes a nearly colorless zone surrounds a dark-green kernel, but usually the prisms are dark throughout. An analysis of isolated material gave:

SiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MnO	MgO	Na_2O	K_2O	Loss
51.82	.60	21.02	8.14	3.01	1.00	1.47	11.87	.85	.50

The arfvedsonite is rare in the normal rock, but is common in its peripheral phases in prismatic grains, whose extinction is 10°30′. The eudialite often possesses an idiomorphic outline bounded by OR, R and ∞P_2. Its double refraction is usually positive, but occasionally some portions of its grains are negative and other portions isotropic.

[1]Fennia. Bull. d. la Soc. d. Géog. de Finlande, 3, No. 7, p. 1.

This phenomenon leads the author to the assumption that eudialite and eukolite are the end members of an isomorphus series, of which the isotropic substances intermingled with the eudialite are intermediate members. Ainigmatite is found only in the peripheral masses as allotriomorphic grains with a pleochroism A = black > B = brown-red > C = carmine. One of the new minerals occurring in the coarse-grained rock has the composition:

SiO_2	Al_2O_3	Fe_2O_3	MnO	CaO	MgO	Na_2O	K_2O	H_2O
55.88	15.19		2.67	9.53	.53	9.06	1.57	6.04

It is isotropic or weakly doubly refracting. It shows no cleavage, is hard, and has a density of 2.753. Its color is light-red except in certain star-like areas where it is more deeply colored. It is one of the youngest of the rock's components. In the normal rock these constituents are so aggregated as to produce the trachytic structure. In the peripheral varieties aegirine, nepheline and the feldspars are in two generations. These minerals and eudialite occur as phenocrysts in a fine-grained green ground mass of the first three mentioned components, sodalite and the new minerals above referred to. The structure of this aggregate is intermediate between the hypidiomorphic and panidiomorphic. A dyke eleolite syenite from the same region has a thoroughly panidiomorphic ground mass.——In the course of a very exhaustive geological article on Mite Vulture, in Basilicata, Italy, Deecke[1] describes the products of the volcano as lavas and tufas. The former, with the exception of the hauyne-trachyte of Melfi, all possess a similar appearance. They are dark, compact or slaggy rocks with phenocrysts of augite and hauyne in a ground mass of leucite, nepheline, feldspar, augite, biotite, melilite, containing sometimes olivine, garnet, apatite and magnetite. The augite is in well formed idiomorphic crystals, both in the lavas and in the tufas. These are zonal with a yellow augite surrounded by a greenish zone, the material of which also separates as small crystals in the ground mass. The hauyne is the next component in abundance. It possesses the usual characteristics of this mineral, and alters into zeolites, of which the most important is natrolite. The leucite, nepheline, plagioclase and sanidine are usually in such small grains as to be visible only under the microscope. The latter mineral occurs also as an essential constituent in 1 cm. long crystals in the phonolite of LeBraidi, East of Melfi, and in some of the tufas. Olivine is found

[1]Neues. Jahrb. f. Min., etc., B. B. vii, p. 556.

only in the rock of the crater and in bombs, though it was probably more abundant during the first stages of consolidation of nearly all the lavas. Melilite and biotite are also rare, and both seem to have undergone more or less resorption. In addition to the minerals above mentioned bronzite is sometimes found in the olivine inclusions, and natrolite, phillipsite, gypsum, serpentine and kaolin as alteration products of other minerals. The most abundant lava of the volcano is leucite-tephrite, with nepheline, leucite, plagioclase and sanidine in varying proportions. A phonolite dyke was discovered at LeBraidi, as already stated. Otherwise phonolitic material is known only as tufa. At Melfi occurs the unique rock, many times described as a melilite hauynophyre. According to the author it should be classed as a hauyne-melilite-nepheline-leucite-tephrite. Basanites cut the older tephritic lavas in the crater of the volcano. Glassy base was detected only in some of the lapilli. The bombs thrown out during the active period of the volcano's history are either olivine bombs or aggregates of augite, biotite and hauyne. In the former the components are olivine, bronzite and biotite, the latter in micropegmatitic intergrowths with the other two. The tufas fall into two classes. In one sanidine and melanite are abundant; in the other hauyne predominates. The first is the older, and includes the trachyte tuffs of earlier authors. It is a tephrite tufa, which sometimes contains little rounded grains of quartz. The hauyne tufa is more widely spread than the tephritic varieties, and is probably connected genetically with the phonolitic lava.

Mineralogical News—General.—Analyses of *långbanite* having led Flink to the complicated formula $37\,Mn_5\,SiO_3 + 10\,Fe_3\,Sb_2\,O_8$ as expressive of its composition, Backström[1] has thought it worth while to re-examine the mineral in the attempt to learn its true relationship to other nearly allied species. A new analysis yielded him:

[1]Zeits. f. Kryst., xix, p. 276.

Sb_2O_5	SiO_2	MnO	FeO	CaO	MgO
13.96	9.58	65.44	3.10	1.73	.53

Since chlorine is evolved when the mineral is treated with hydrochloric acid, the author concludes that the manganese is principally in the form of Mn_2O_3, while the remainder of the metal is present as MnO. The conclusion reached is to the effect that langbanite is not isomorphous with any known mineral, but is an isomorphous mixture

of Mn SiO_3, Mg SiO_3 and Mn SbO_3.——A large number of *chlorite* analyses are communicated by Ludwig,[1] to whom material was furnished by Teshermak. Among the varieties whose composition was determined are *pennine*, from the Zillerthal, *cronstedtite*, from Pribram, *korundophilite*, from Chester, Mass., *metachlorite*, from Elbingerode, *daphnite*, from Penzance, *tabergite*, from Taberg, *prochlorite*, from the Zillerthal and the Fischerthal, *leuchtenbergite*, from Amity, N. Y., and *clinochlor*, from Achmatowsk, Russia, and from Kariet, Greenland. The figures for korundophilite and leuchtenbergite follow:

	SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	H_2O	Sp. Gr.
Korund..... ...	23.84	25.22	2.81	17.06	19.83	11.90	2.87
Leucht.....	30.28	22.13		1.08	34.45	12.61	2.68

These analyses of Ludwig and others that have recently been reported have afforded Tschermak[2] data for the elaboration of a theory concerning the constitution of the chlorites, according to which the members of this group of minerals are regarded as consisting of mixtures of six molecules, four being represented by the known minerals serpentine, amesite, strigorite and chloritoid, and the other two being hypothetical. Dr. Clarke[3] takes exception to Tschermak's views and shows that upon his own theory (that the chlorites are substitution derivatives of normal salts) the composition of these complicated minerals becomes simple, and that his theory is as closely in accord with the facts known as to the structure of the chlorites, as is the theory of the Vienna mineralogist.——In a discussion as to the relations of the recently discovered minerals pinakiolite and trimerite to well known groups Brögger[4] places the former among the rhombic aluminates, and the latter, as a pseudo-hexagonal species, between the olivine and the willemite groups. He further points out the similarity in morphological properties between all of these groups and ascribes their differences to morphotropic action. He regards all the silicates of the general formula R_4SiO_4 as composing a morphotropic group, in which trimerite is triclinic because R is replaced by two elements, viz: Be and Mn--Several *micas*, *vermiculites*, and *chlorites*[5] have been investigated by Messrs. Clarke and Schneider[6] by the

[1]Min. u. Petrog. Mitth. xii, p. 32.
[2]Akad. d. Wissens. in Wien. , 1891.
[3]Amer. Jour. Sci., xliii, 1892, p. 190.
[4]Zeits. f. Kryst., xviii, p. 377.
[5]Cf. Becke: Min. u. Petrog. Mittl., xi, p. 259.
[6]Amer. Jour. Sci., Sept., 1891, p. 242.

methods[1] already noted in these pages. Some of the vermiculites seem to be composed simply of mica molecules, while in others these are intermingled with molecules possessing the characteristics of those of chlorite. Many analyses of vermiculites appear in the paper, and all of them bear evidence of careful work.——*Calcium-vanado-pyromorphite*[2] occurs in the Leadhills, Southern Scotland, as black masses with an irregular fracture. It melts easily to a brown crystalline enamel, and dissolves in hydrochloric acid, leaving a brown residue. Its density is 6.9–7.0, and in composition it is a pyromorphite with its lead and phosphorus partly replaced by calcium and vanadium.——

$Pb_3(PO_4)_2$	$Pb_3(VO_4)_2$	$Ca_3(PO_4)_2$	$PbCl_2$	$Cu(OH)_2$	Insol.
52.00	19.20	15.80	11.05	1.50	0.6

Crystallographic.—*Barite* crystals from veins cutting limonite and siderite, forming lenticular masses in limestone, interstratified with crystalline schists at Huttenberg, Saxony, have been studied by Brunlechner[3]. They are supposed to have originated by the leaching of barium silicate and its decomposition through the agency of carbonic acid into barium bicarbonate and silica, and by the further action of iron sulphate upon the barium salt. Well formed crystals are rare, but the author has succeeded in detecting upon them twenty-nine forms, of which the following are new: $\infty P\breve{\frac{11}{4}}$, $\infty P\breve{2}\bar{2}$, $\infty P\breve{3}\bar{0}$, $\infty P\breve{4}\bar{4}$, $\infty P\bar{\frac{6}{5}}$, $16P\breve{\infty}$, $20P\breve{\infty}$ and $4P\bar{\frac{7}{4}}$.——An examination of the crystals of *ullmanite* from Sardinia, in the possession of the British Museum, inclines Miers[4] to regard them as interpenetration twins of tetartohedral forms, whose apparent holohedral symmetry is due to twinning about the dodecahedral axis. If this is so, ullmanite is the first regular tetartohedral mineral known.——Melville[5] has investigated the diaspore crystals in the cavities of the quartz diaspore rock of Mt. Robinson[6]. One type consists of light-brown transparent forms, elongated parallel to *c*. Its planes in the order of their development are $\infty P\breve{\infty}$, ∞P, $\infty P\bar{2}$, $\infty P\bar{\frac{4}{3}}$, $\infty P\bar{\frac{7}{6}}$, $P\breve{\infty}$, P and $P\bar{2}$, with the axial ratio = .6457 : 1 : 1.0689. A second type comprises almost white, opaque crystals with a stout pyramidal habit, bounded by $\infty P\bar{2}$, $P\bar{2}$ and $\infty P\breve{\infty}$.——A very elabor-

[1]American Naturalist, 1891, p. 830.
[2]Collie: Jour. Chem. Soc., lv, 1889, p. 91.
[3]Min. u. Petrog. Mitth. xii, p. 62.
[4]Min. Magazine, ix, p. 211.
[5]Am. Jour. Sci., June, 1891, p. 470.
[6]Cf. American Naturalist, 1892, p. 166.

ate paper on the *vesuvianite* crystals in the serpentine of Testa Ciarva, Alathal, Piedmont, adds but little to our knowledge of these. The results recorded in it but confirm Zepharovich's observations. The crystals examined by the author, Strüver[1], numbered 123, each one of which was carefully measured, both as regards its dimensions and the planes occurring upon it. The number of forms found on each crystal is stated, and the number of crystals upon which each form was observed is mentioned. A plate appended to the article contains thirty-two figures, showing the arrangements of striations and the shapes of elevation and depression figures on the different faces.——In the second part of his article on the symmetry of crystals Beckenkamp[2] gives us some exact information concerning the vicinal planes and the etched figures of the *aragonite* of Bilin and the neighboring localities in Russia, and discusses the polarity of the crystal molecule, with especial reference to the explanation of the electrical properties of the carbonate and of its vicinal planes. The axial ratio of the aragonite crystals examined is .6228 : 1 : .7204.——In a recent article Sohncke[3] explains the structure of circularly polarizing crystals on the basis of his point-system theory of crystal-structure. He succeeds in showing that circularly polarizing crystals may be regarded as composed of thin lamellæ of doubly refracting substance, in which the different layers are revolved a certain number of degrees around their common axis.——Some very complicated twins of feldspar from the Pantelleria rocks are described by Foerstner[4]. They exhibit in the same group combinations of all the principal twinning laws known for the species. ——The *calcites* of fifteen localities in Baden have undergone the same exhaustive examination in the hands of Sansoni[5] as have those of so many other well known occurrences.——Miers[6] has measured the fourth crystal of *krennerite* ($Au_3 Ag_3 Te_6$) reported in mineralogical literature. It is from Nagyag, Hungary, and contains six new forms, viz.: $2P\breve{\infty}$, $3P\breve{\infty}$, $4P\breve{\infty}$, $2P\breve{2}$, $3P\breve{2}$ and $\frac{1}{2}P\breve{2}$. The axial ratio is 1.0651 : 1 : .5388.

Miscellaneous.—Following the work of Clarke and Schneider on the constitution of the natural silicates comes the report of a series of

[1]Neues. Jahrb. f. Min., 1891, p. 1.
[2]Zeits. f. Kryst. xix, 1892, p. 241.
[3]Ib., xix, p. 530.
[4]Ib., xix, p. 560.
[5]Ib., xix, p. 321.
[6]Miner. Magazine, ix, p. 182.

investigations on similar bodies made by Thugutt[1] in Dorpat. The author recounts the results of his experiments of digesting certain compounds with water and various chemicals for a long time at a high temperature, and describes minutely the products formed. By using the proper ingredients a series of sodalites was produced, in which sodium silicate, the corresponding selenite, sulphite, chlorate and other salts take the place of the chloride in the most common sodalite. The details of the experiments cannot be given, although they are extremely interesting. The formula thought to represent best the chemical properties of natural sodalite is $4(Na_2O, Al_2O_3, 2SiO_2) + 2\,Na\,Cl$. The treatment of corundum, a few silicates and natural glasses with water and alkaline carbonates shows clearly that each reagent is efficient in hydrating the substances upon which it acts. Many other conclusions of interest are reached through the author's investigations, but they cannot be mentioned here for lack of space.

BOTANY.

Myriostoma coliforme Dicks. in Florida.—A note upon the rare occurrence of *Geaster coliformis* may be seen in the ninth volume of Grevillia. It was found in England and first recorded in Ray's Synopsis in 1724; with long intervals it has been seen a few times since. It has been met with in a few localities on the continent. When I wrote the article on N. A. Geasters in THE AMERICAN NATURALIST in 1884, I was not aware that *Myriostoma coliforme* had ever been found in this country, but that paper brought out the fact that a specimen which came from Colorado was in the N. Y. State Museum of Natural History. This I noticed in the Journal of Mycology, Vol. I, No. 1.

Last summer Prof. L. M. Underwood found a nest of this rare and curious fungus in the vicinity of Eldorado, Fla. Through his kind consideration and liberality, I have come into possession of three specimens.

As no account of the internal structure has ever been given, I was eager to examine its interior and proceeded shortly to carve the largest specimen. A study of this enables me to fortify the opinion of Desvaux that this interesting species of the tribe *Geaster* should of itself constitute an independent genus. But let us examine it carefully beginning with the mycelium and the external surface.

[1]Mineralchemische Studien, Dorpat, 1891, p. 128.

Contrary to my surmise from the published description, the peridium is not invested with a thin frail cuticle emitting from all points of the surface slender filaments which bind it to the soil, as in *Geaster limbatus*, but a fibrous rooting mycelium proceeds from the lowest central point of the base, as in *Geaster saccatus*; hence the cuticle is persistent. A stout fibrillose layer succeeds forming the main structure of the plant and connecting with the inner peridium at the base by the numerous pedicels. These are angular or prismatic in shape, sometimes rather flattened and just about 2 mm. in length. A thin fleshy layer lines the inner surface, which is not at all hygrometric as in *Astræus*. The inner peridium is depressed-globose and has the silver-gray lustre mentioned by the old botanists; the surface also is roughened with minute pointed warts, as noticed by Plowright, and this fact leads me to infer that the inner and outer peridium are at first united by what De Bary terms a *split-layer*, as is the case in *Astræus hygrometricus*.

Now as to the internal structure. There is no columella such as we find in all true Geasters. The inner peridium has a soft fleecy lining of fine slender threads, in the dry state much curled and entangled. By careful manipulation, I found each thread to be a long simple structure, brownish in color by transmitted light, 3–4 μ in thickness in the middle and tapering to a fine point at each extremity; it is attached to the membranous wall by one end and of course is free at the other; so far the agreement of the threads is with those of *Geaster*, but a peculiarity now occurs.

The pedicels fuse at once into the wall of the peridium and are not erected in any way into one or more columellas. Instead the threads of the fleecy lining concentrate at numerous points upon the base, elongate and becomes compacted together forming several irregular branched processes, which attain half the height of the peridium. These processes remind me forcibly of the numerous dendroid columellas which are erected from the base in the Myxomycete, *Reticularia lycoperdon*; indeed the silvery surface of the peridium in the two is altogether similar.

Mingled with the spores, I find numerous *free* threads similar to those which grow upon the inner face of the wall but much shorter; I suspect that these grow upon the trama along with the spores and are left free by deliquescence as in *Bovista*. If this is true it is a unique feature. But I am not able to assert this positively from the mature specimens.

The numerous mouths do not appear to have any correspondence either in number or position to the pedicel. It is doubtful to me whether they are determinate, but they seem rather to be ruptures at thin and weak spots between the warts. At any rate they are not regularly fimbriate as in many of the Geasters, but such a fimbriate appearance as may be seen is due to the protrusion of the threads of the fleecy lining by the emission of the spores.

It is therefore most probable that *Geaster columnatus* Lev. must be included in the species under discussion, and there is hence but this one unique species as yet known in the world.—A. P. Morgan, Preston, O.

Notes on Ginseng (*Aralia quinquefolia*).—Ginseng root is now dug in large quantities in Canada and exported from Canada to the United States, to supply the demand among the Chinese. In order to prevent its eradication the parliament of Ontario has found it necessary to pass a law prohibiting the digging of it except at certain seasons.

This trade is a revival of one of which formerly existed. In 1715 Père Lafitan, a Jesuit father, who was stationed near Montreal, saw a letter of Père Jartoux, who had seen ginseng in Tartary a few years before and gave a description of it. Père Lafitan, ascertaining that the root was worth its weight in gold at Pekin, and that there was "large money" in it, searched the country, and inquired from the Indians, in order to find it, which he succeeded in doing. A company was formed to export it to China, Japan and Tartary. The price at Quebec was from thirty to forty cents a pound. At first anyone was allowed to sell it, but as its value increased the company exercised its monopoly rights, and in 1751 undertook to exclude all others from the trade. As the demand increased the care exercised in procuring and preparing the root relaxed. It was dug out of season, and imperfectly dried in stove ovens. As a result the value of the export fell off from five hundred thousand livres in 1752 to thirty-three thousand livres in 1754. Canadian ginseng came to have such a bad reputation that the export ceased entirely.

When the trade was at its height it was considered more profitable to dig ginseng than to cultivate the farm, and agriculture was almost entirely neglected. For a time the trade was hardly less important than that in fur.

The revival of the demand has caused great activity in the search for ginseng, especially in the country to the north of Kingston, Ont.,

where it is said to abound. The average wholesale price is one dollar per pound, while it retails at five dollars. In the desire to participate in the large profits made in this trade some curious mistakes have been made. A man who thought he had a rich find in Manitoba, discovered, after buying several tons, that he had not the right article, having probably confused gentian with ginseng.

If the trade is to be preserved care will have to be exercised in digging and preparation. The root does not reach any great size in one season, but takes years to develop.

The Chinese word *genseng* and the Iroquois word *garent-oquem*, the Indian name of the plant both signify "a man's thigh," and have doubtless been applied because of a fancied resemblance of the human body. Upon this coincidence Père Lafitan based an argument that America had once been joined to Asia, and that the inhabitants of the former had migrated from the latter before the continents had become separated at Bering Strait.

Panax fructicosus and *Panax cochleatus*, fragrant aromatics, which grow in the Moluccas, and are used by the native practitioners of India, are plants somewhat akin to ginseng. The native Chinese ginseng is probably another species of the same genus as that found on this continent.—J. Jones Bell, Toronto, Canada.

Popular Botany.—It is a good sign of the increase of biological ideas in connection with botany when one finds such a book as "A Song of Life," which has recently came from the pen of Margaret Warner Morley, and which A. C. McClurg has brought out in such an attractive form. The first chapter only, "Flowers," relates to plants, the others dealing with fishes, frogs, birds, etc., but in spite of its title it discusses flowers less, and plant life, and reproduction more. The illustrations are very good, and most artistically arranged below, above and through the pages of poetically worded, and withal quite exact text. We hope to see more of such books.

Jane Newell's "Flowers and Fruits," recently brought out by Ginn & Co., continues the pleasant and instructive lessons begun a couple of years ago. They are designed "for the use of teachers, or mothers studying with their children." The book will be useful.—Charles E. Bessey.

ZOOLOGY.

Fresh-Water Sponges.—Prof. D. S. Kellicott has arranged the fresh-water sponges collected by the late Henry Mills and has published an account of them[1] with a key to the genera. Sixteen species are enumerated. Prof. Kellicott regards the region around Buffalo bay as affording ideal conditions for a fresh-water fauna as the water remains at an almost constant level, and with comparative moderate changes in temperature.

Parasites of Salmon.—F. Zschokke,[2] after a careful study of the parasites of *Salmo salar*, the author comes to the following conclusions: 1. Thirty-three species of helminths infest the salmon; 2. The habits of *S. salar* differ in different bodies of fresh water, for (a) the absence of fresh water parasites in the Rhine salmon shows that in this stream no food is taken by them, (b) the occasional presence of fresh water parasites in the salmon of the Tay proves that food is occasionally taken in that stream, (c) while the very frequent presence of fresh water parasites in the salmon of the Baltic Sea shows that it is the regular custom of this fish to feed in the rivers and brackish water of that region.—C. W. Stiles.

Anatomy of Stenostoma.—H. N. Ott publishes[3] a preliminary note on the structure of this Rhabdocœlous Turbellarian which is essentially like most Microstomidæ, the relations of the muscles of the body walls which is called peculiar, being the normal condition in the Turbellaria. The olfactory pits are imbedded directly in the brain. In fission a constriction of the ectoderm precedes alteration of the entoderm.

The Systematic Position of Orthelosoma.—L. v. Graaf has had an opportunity to study the type of this genus in the British Museum, described by the late J. E. Gray as a slug. He finds[4] that, as Leuckart had previously supposed, this so-called mollusc is in reality a land Planarian, closely allied to Rhynchodesmus. Von Graaf states

[1]Bulletin Buffalo Soc. Nat. Sci., V., p. 99, 1891.

[2]Die Parasitenfauna von Trutta salar, in Centralblatt für Bakt. u. Parasitenkunde, 1891, Vol. x, No. 21–25.

[3]Zool. Anz. xv., p. 9., 1892.

[4]Zool. Anz. xv., p. 8., 1892.

that the type of Guilding's Herpa from the West Indies is not to be found. It was also described as a mollusc, but it has Planarian characters.

Haplodiscus.—L. von Graaf[1] gives his opinion of Weldon's *Haplodiscus piger* from the Bahamas, which was thought by its describer to be possibly allied to the Cestodes or Trematodes. It is, says von Graaf, an acœlous Turbellarian, with zooanthellæ, with central mouth, two genital openings and apparently with a chitinous terminal portion to the bursa. These characters would assign it to the genus Convoluta.

Echinorhynchi in America.—It has long been known that the swine in this country are commonly affected with these parasites. Dr. C. W. Stiles has recently solved the problem of the intermediate host of the worm (Zool. Anz. xv, p. 52, 1892). In Europe it had been demonstrated that two or three of the Scarabæid beetles acted as such host and so they were used as the basis of experiment here. Eggs of Echinorhynchus were sprinkled on the food (tender roots, etc.) of the larvæ of Lachnosterna and subsequent investigation showed that the larvæ were distended with the young. As farmers are in the habit of turning their hogs into fields which are infested with the 'white grubs'—larvæ of the June bugs—it is easy to see how the parasites can be communicated to the swine, provided, of course, that the grubs be affected. On the other hand the grubs may be readily infected from the fæces of a single infested hog.

The Species of Panopæus.—James E. Benedict and Mary J. Rathbun monograph[2] the species of this essentially American genus of Cancroid Crustaceans. Eurytium and Eurypanopeus are included as synonyms. Twenty-four species have been examined and as a supplement a list of fifteen more nominal species is given of which no specimens have been seen. Some three thousand specimens were examined in the preparation of the paper. The present writer once studied this genus but did not publish his results. He is of the opinion that the number of species here admitted is about three times too large, for the species are very variable.—K.

Pycnogonid Studies.—Schimkewitsch[3] revises the species of the genera Phoxichilus and Tanystylum. In the introduction Wilson's

[1]Zool. Anz. xv., p. 6, 1892.
[2]Proc. U. S. Nat. Mus., xiv, 355, 6 pls., 1891.
[3]Arch. Zool. Exp., ix, 503, 1891.

genera Anoplodactylus and Scæorhynchus are regarded as synonyms of Phoxichilidium and Eurycyde respectively.

Gamasid Mites and Ants.—Mr. A. D. Michael, in a paper read before the Zoological Society of London, Dec. 1st, 1891, came to the following conclusions: (1) That there is an association between some Gamasids and Ants; (2) That a species of Gamasid usually associates with one or two species of Ants preferentially; (3) That the Gamasid of ants nests are not usually found elsewhere; (4) That the Gamasid abandons the nest if the Ant does; (5) That the Gamasids live upon friendly terms with the Ants; That the Gamasids are not true parasites; (7) That they do not injure the Ants or their young; (8) That the Gamasids will eat dead Ants, and are probably either scavengers or messmates.

Lepidoptera of Buffalo.—E. P. van Duzee publishes[1] a list of the Macro-Lepidoptera of the vicinity of Buffalo, N. Y. In all 777 species are enumerated. In the arrangement W. H. Edwards is followed for the butterflies and Aug. Grote for the Moths excepting the Sphingidæ and Agrotidæ, where J. B. Smith has been followed, and the Phycidæ, which are arranged according to G. D. Hulst.

The Position of the Solenoconchæ.—Dr. L. Plate,[2] after a brief account of the structure of Dentalium, Siphonodentalium, Siphonentalis and Cadulus, concludes that these forms show more relationship to the Gasteropods than to the Lamellibranchs in "(1) the unpaired shell; (2) the radula; (3) the jaws; (4) the tentacles, which can only be homologized with those of the Gasteropods; (5) the body retractors, which in origin and position correspond to the spindle muscles; (6) the pleural ganglia, which among the Lamellibranchs occur only in the Nuculidæ, forms which otherwise show no special similarity to the Dentalia; (7) the strong development of the buccal nerve centres; (8) the œsophageal glands, which from position are to be homologized with the salivary glands of the Gasteropods. Grobben's hypothesis that 'the Dentalia are to be regarded as the survivors of an ancestral form and especially the ancestors of the Cephalopod' is supported [upon the supposition that] the arms of the cuttle fishes, as appendages of the head, are homologous to tentacles of the Solenoconchæ. It appears to me that recently the pedal nature of the

[1]Bulletin Buffalo Soc. Nat. Sci., V., p. 105, 1891.
[2]Verh. Deutsch. Zool. Gesellsch. i. 60, 1891.

Cephalopod arms has been certainly shown.'" Prof. Grobben at the same meeting replied saying, among other things, that the radula and pleural ganglia had no diagnostic value, since there was some evidence that the ancestors of the Lamellibranchs had a radula which had secondarily been lost, while the existence of the pleural ganglia in the Nuculidæ, the oldest of existing molluscs, had great weight. He had no ground to alter his previous view that the Dentalidæ were the modified descendants of the group from which the Cephalopods had sprung. The arguments advanced by Plate for regarding the arms of the cuttle fishes as pedal were not conclusive. Profs. Bütschli and Leuckart spoke to a similar effect, the latter assigning these forms a middle position between Gasteropods and Lamellibranchs.

The Genera of Enteropneusta.—Prof. Spengel[1] recognizes among the 19 known species of this group four genera, separated most sharply by the body musculature. In Ptychodera alone is there an outer circular musculature; Glandiceps and Schizocardium have inner circular muscles, while in Balanoglossus proper no ring muscles exist. Other differential characters are given. Cephalodiscus is not recognized as a member of the group. No species are mentioned.

Extinct or Nearly Extinct Vertebrates.—Mr. A. F. Lucas has a readable article upon the animals which are recently extinct or threatened with extinction as represented in the National Museum.[2] The West Indian Seal (*Monachus tropicalis*), is uncertainly placed in this category for but little is known of it, and its habits and habitat seem favorable for its perpetuation. The California sea-elephant (*Macrorhinus angustirostris*) is possibly entirely extinct, none having been recorded since 15 were sent in 1884 to the National Museum. The walruses, too, are threatened with extinction, the Pacific species, *Odobœnus obesus*, being in greater danger than the Atlantic *O. rosmarus*. The source of danger lies in the whalers who capture the animals for oil and ivory. Between 1870 and 1880 there was brought to market 1,996,000 gallons of walrus oil, and 398,868 pounds of walrus ivory. In 1879 the ivory was worth 45 cents a pound; in 1880, $1.00 to $1.25; and in 1883, $4.00 to $4.50. The European bison (*Bison bonasus*) which is at present restricted to Lithuania and the Caucasus, is protected in both localities. In 1880 the Lithuanian herds numberd but 600 and the number is smaller at present. The

[1]Verh. Deutschen Zool. Gesellsch. i. 47, 1891.

[2]Report National Museum for 1888–89, p. 609, 1891.

Arctic sea-cow, (*Rytina gigas*), the history of which has already been given in our pages,[1] was exterminated in 1767 or 1768.

Three species of birds from the Hawaian Island are probably extinct. The last ornithological collector who returned from these islands found no specimens of the Mamo (*Drepanis pacifica*), and but about half a dozen specimens represent the species in museums of the world. It was probably exterminated in obtaining feathers to make the yellow war cloaks of the Sandwich Island Kings. The Hawaian *Chætoptila augustipluma* is represented but by two specimens, and the small tailless rail (*Pennula ecaudata*) of the same archipelago is nearly as rare. It would appear that nearly all the native birds of the islands are also threatened with extermination.

The California Vulture (*Pseudogryphus californianus*) is now extremely rare, and largely restricted to Southern California. "The free use of strychnine in ridding the cattle ranches of wolves and coyotes has caused the disappearance of this bird, which has been poisoned by feeding on the carcases prepared for the four-footed scavengers." The Dodo (*Didus ineptus*) of Mauritius, and the Solitaire (*Pezohaps solitaria*) of Rodriguez, have a history too well known to be recounted here. They are represented in the National Museum by a few bones.

So, too, the fate of the Labrador duck (*Camptolæmus labradorius*) and of the great Auk (*Alca impennis*) has often been told. Of the former but 36 specimens are in existence. Two of these in the National Museum were collected by Daniel Webster. The last specimen was taken in 1878. Specimens of the Great Auk are not so rare, and yet they command enormous prices. The last skeleton sold brought $600, the last skin $650 and an egg brought $1500. The Great Auk was probably exterminated in 1840.

Pallas' Cormorant (*Phalacrocorax perspicillatus*) of the region around Kamschatka has a brief history. It was killed by man for food. In 1741 it was "frequentissimi" on Bering Island. About a hundred years later it was extinct and is represented to-day by four stuffed specimens and twenty-three bones in all the museums of the world.

Of the lower vertebrates Mr. True refers to the great Galapagos tortoises and their relatives of the Mascarene Islands, and the Tile fish. The forms have already formed the subject of a paper by Dr. Baur in this Journal[2] and it is only necessary to say that probably

[1] L. Stejneger Am. Nat., xxi, p. 1047, 1887.

[2] Am. Nat. xxiii, p. 1039, 1889.

they are exterminated from another of the Galapagos group. The giant tortoises of the Mascarene Islands were extremely abundant in the seventeenth and eighteenth centuries, but their use as food caused their extinction at the beginning of the present century. "Save the few bones rescued from the marshes of Mauritius and the caves of Rodriguez, nothing is left to show that these large and formerly abundant tortoises ever existed."

The history of the Tile fish (*Lopholatilus chamæleonticeps*) is among the strangest known. So far as we have any information, no one, fisherman or naturalist, ever saw a tile fish (the common name is an abbreviation of the generic) until March 1879, when a Gloucester fishing schooner took about 6000 pounds. In the following years 1880 and 1881 a few were taken by the U. S. Fish Commission Steamer. In March and April 1882 vessels arriving in American ports reported passing through large numbers of dead and dying fish off the southern coast of New England and Long Island. Vessels reported sailing for forty to sixty miles through floating fish, (in one instance through 150 miles) so that it became evident that a vast destruction had taken place. Capt. Collins estimates from these reports that an area of 5000 to 7000 square statute miles were so thickly covered that the total numbers must have exceeded a billion. The next fall the Fish Commission searched in vain for these fish on the ground where they were formerly so abundant; and no one has since reported a specimen.

Zoological News.—Vertebrates.—Carl H. and Rosa H. Eigenman publish[1] a very useful catalogue of the fresh-water fishes of South America. 1135 species are enumerated. The great richness of the fauna in the Nematognathi is here made very prominent, 449 species of that order being enumerated.

Mr. A. J. Allen[2] publishes the first part (Osines) of a catalogue of the birds collected by Mr. Herbert H. Smith at Chapada, Matto Groso, Brazil. Mr. Smith and his party obtained some 6000 skins in this locality and of these some 5500 are utilized in preparing the present paper. In all the collection represents about 350 species in all phases of plumage. 87 species are included in the present paper.

At a meeting of the Zoological Society of London, Feb. 2, 1892, R. Lydekker "described part of an upper jaw of a Sirenian Mammal

[1]Proc. U. S. Nat. Mus., xiv, p. 1–81, 1891.

[2]Bull. Amer. Mus. Nat. Hist., iii, p. 337, 1891.

from the Tertiaries of Northern Italy, containing milk teeth. As these teeth showed a masked Selenodont structure it was urged that the specimen indicated the descent of the Sirenia from the Selenodont Artiodactyle Ungulates;" an exceedingly improbable suggestion.

ENTOMOLOGY.

The Robertson Cyanide Bottle.—Many entomologists have experienced more or less trouble in using the commonly recommended plaster-of-Paris cyanide bottle on account of the moisture that accumulates on the inside. I was recently shown by Professor Chas. Robertson, of Illinois, a plan he has adopted which is simple, practical, and causes no trouble of this kind. He uses wide-mouthed bottles with cork stoppers. He cuts out of the lower side of the cork a hole large enough to receive a small pill box. The pill box is filled with cyanide; a dozen pin holes are made through its bottom; and then it is inserted in the hole in the cork. The fumes pass through the pin holes into the bottle. Such a bottle can be easily washed out, and has many advantages especially for flies, bees and similar insects.—C. M. W.

Entomological Notes.—Professor A. J. Cook, of Michigan, spent the winter in Southern California. * * * Professor J. H. Comstock of Cornell University has been at the Leland Stanford Junior University during the winter, lecturing on entomology. * * * Professor Chas. Robertson, of Illinois, is studying the relations of flowers and insects in Florida. * * * Professor J. B. Smith, of Rutgers College, recently visited Europe to study types of Noctuidæ.. * * * Miss Mary E. Murtfeldt has contributed to the December *Insect Life* an interesting note on the "Hominivorous Habits of the Screw Worm in St. Louis." * * * Mr. Albert Koebele, of the U. S. Department of Agriculture has gone to Australia for more beneficial insects.

Professor Forbes' Sixth Report.—The seventeenth report of the State Entomologist of Illinois for the years 1889 and 1890 has lately been issued. Like its recent predecessors it gives evidence of the careful, exhaustive work so characteristic of Professor Forbes' investigations. The report proper covers about 100 pages with an appendix of 40 pages. In the general record for the two years covered it is stated that the previous prediction concerning the disappearance of the chinch bug outbreak had proven correct. Two species of aphides (*Siphonophora granaria* and *Toxoptera graminum*) had appeared in the grain fields; the former having "inflicted the worst injury upon agriculture ever done in Illinois by any plant-louse species." The general discussions include the following titles: "The

Fruit Bark Beetle" (*Scolytus rugulosus*), the best article concerning this insect yet published; "Experiments With the Arsenical Poisons for the Plum and Peach Curculio," showing the susceptibility of the beetles to poisoning; "The American Plum Borer" (*Euzophera semifuneralis*) with description of stages and notes on life history; "On the Common White Grubs," an important contribution on a little-known subject; "Additional Notes on the Hessian Fly," showing the life-cycle of this pernicious pest; "A Summary History of the Corn Root Aphis," "On a Bacterial Disease of the Larger Corn Root Worm" and "Notes on the Diseases of the Chinch Bug." The appendix consists of "An Analytical List of the Entomological Writings of Wm. Le Baron, M. D., Second State Entomologist of Illinois," and is accompanied by a well executed plate portrait of Dr. Le Baron. The report is also illustrated by three colored and four plain plates of original drawings by Mr. A. M. Westergren. The colored plates represent the corn leaf louse, corn root louse, and the grain louse, in a most accurate and artistic manner.—C. M. W.

The Illinois Insectarium.—In his recent Sixth Report, noticed above, Professor S. A. Forbes gives the following account of the Insectarium recently provided for the State Entomologist of Illinois: "The experimental work of the office has been greatly facilitated, and rendered far more accurate and profitable by the new Insectarium, or experimental entomological laboratory, provided for by the Legislature at its last session. It has been in constant and extensive use from the date when it was ready for occupancy.

"The important part of this Insectarium is essentially a conservatory fifteen feet by thirty, standing entirely above ground with glass roof and brick walls, with the exception of the end wall which is glass above the level of the sides. The building stands north and south, opening to the south with double doors, one of glass and one of wire gauze. The roof is covered with four rows of sash all hinged at the ends in such a way that the sash of the lower row can be lifted at the lower end, while the sash of the upper row may be opened widely at the peak of the roof. The glass on the lower row of sash upon each side is deadened with white paint (that of the upper row being left clear) and the admission of sunlight is further controlled by a screen of cheesecloth sliding on wires extending along the entire middle of the room beneath the two central rows of sash. The upper sashes are opened and closed by a ventilating apparatus which moves all together, while the lower are conveniently raised by hand. The

room is divided into two apartments connected with double doors, one of which is provided with hot water pipes.

"With these arrangements it was easy to keep the temperature within one or two degrees, above or below, that of the outer air, whatever the weather might be. The interior is furnished with tables in benches, work-tables, etc., for breeding-cage and root-cage work, and contains a brick-lined trench, three feet wide and fifteen feet long by three feet deep, cemented within, and filled with earth, for the larger plants, and for small plot experiments."

MICROSCOPY.[1]

Notes on Celloidin Technique.—The high value of celloidin as an imbedding mass is well-known, and its superiority over all methods requiring heat is unquestioned, yet, from the fact that its manipulation has been attended by many difficulties, it has not come into general use. During the past two years I have tried the methods recommended by various authors and have found none entirely satisfactory, especially where very long series were necessary. The results of my experience are embodied in the following method:

The prepared plates or fragments are placed in an air-tight chamber; a four-ounce salt-mouth bottle being very suitable for this purpose. Pour into this bottle just enough ether-alcohol (equal parts acid-free sulphuric ether and absolute alcohol) to cover the fragments. The ether-alcohol should be added until after occasional shaking no celloidin remains undissolved; this may take several days. It should finally possess the consistency of a very thick oil. The solution thus obtained may be labelled No. 4. No. 3 is obtained by taking two volumes of No. 4 and diluting with one volume of ether-alcohol. No. 2 by proceeding in a like manner with No. 3. No. 1 is a mixture of absolute alcohol and sulphuric ether in equal parts.

The saturation and final imbedding is accomplished thus: The object is transferred from 95% alcohol to solutions 1, 2, 3, 4 successively, in each of which it remains from a few hours to days, depending upon the size and permeability. For pieces of tissue 2 mm. in diameter twenty-four hours in each will generally suffice. For a large brain, *e. g.* that of a cat, a week in each will not be too long.

In imbedding, unless orientation is desired, the ordinary paper box is best. A thin plate of lead is placed in the bottom and the imbed-

[1]Edited by C. O. Whitman, Clark University, Worcester, Mass.

ding solution poured in. The object is taken from the same solution and with needles wet in ether placed in the desired position. Fine needles may be passed through the box to support the object.

In hardening, the method given by Viallanes of immersing in chloroform is preferable, since the operations may be carried on with much greater rapidity. An air-tight chamber should be filled with chloroform; a very wide-mouth bottle will answer. After the mass is thoroughly hardened, which requires about twenty-four hours, it is removed, the paper cut from the sides and transferred to 70% alcohol for a few hours.

It is now ready to fix for sectioning. Blocks are trimmed to fit the clamp of the microtome. Solution No. 3 is poured over the block; into this the celloidin block is pressed, after dipping the under surface in solution No. 1. Place in chloroform until hardened.

Reconstruction points are often very desirable. For this purpose the ordinary metallic imbedding box (fig. 1) made of two L-shaped pieces, *a* and *á*, held in place by the overlapping strips *b*, is used. The ends and sides are perforated in as many places as desired by a very small drill. The holes should be so drilled that the silk threads which are drawn through run parallel. After being drawn tightly they are cemented to the sides of the box by a drop of celloidin. Five or six cm. of the thread should be left hanging. The bottom of the box is made by fitting in a piece of heavy blotting paper. The object is placed upon the threads in the desired position, and the imbedding mass poured in. As soon as hardened the celloidin holding the threads is dissolved by a drop of ether. The loose ends are soaked in solution No. 2, which has been thickened by the addition of lampblack. The threads are then drawn through, leaving the lampblack adhering to the celloidin, thereby forming excellent reconstruction points.

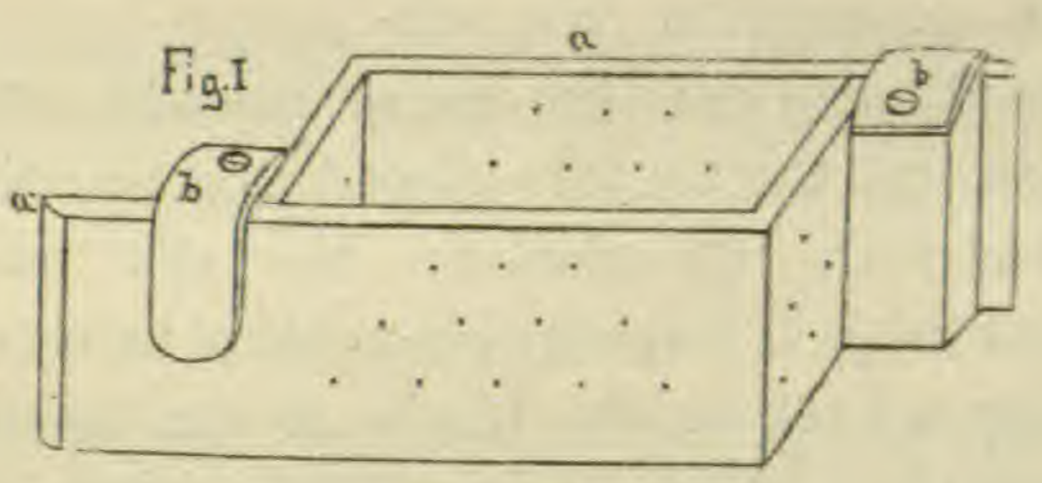

FIG. I.

For small objects where reconstruction points are not needed the following method may be advantageously employed. The heads are clipped from fine insect pins, which are then placed in handles in such a way that they may be easily removed. On these pins the objects are oriented in the desired position; the pins are then removed from the handles and fixed in a cork (fig. II, *a*) previously perforated by a

somewhat larger pin. As fast as the pins carrying the objects are inserted the cork is replaced in the tube, which is filled with alcohol. A half dozen fish or amphibian ova may be oriented on the same cork. If desirable to draw the objects *in situ* a piece of lead may be pinned to the cork and the whole immersed in a small beaker of alcohol. The corks carrying the oriented objects are transferred successively to tubes containing the different solutions. When ready for final imbedding a piece of porous paper is wrapped about the tubes and cork and pinned. The cork is now removed, allowing the imbedding solution to fill the paper tube thus formed. A lead is fastened to the cork and the whole placed in chloroform until hardened, after which the paper is cut from the mass and the pins drawn through the cork, when it is ready for sectioning. This method offers many advantages in that several objects may be cut at the same time, drawings may be made after orientation, the objects are transferred from one solution to another more rapidly, etc.

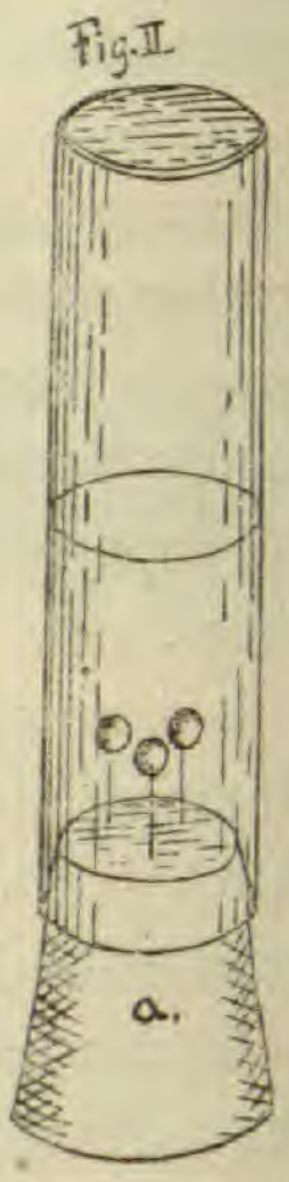

FIG. II.

In cutting, care should be taken that the knife is placed as obliquely as possible and kept constantly wet with 70% alcohol. For this purpose an ordinary pipette provided with a large rubber bulb is used. As fast as cut the sections are drawn back on the blade of the knife, by means of a needle, and arranged in a single row until the blade is filled. To remove them a heavy paper spatula is placed directly upon the section to which it adheres and may be drawn off the edge of the knife and transferred to the slide. By slight pressure together with a rolling movement the section is left in the desired position. Sufficient alcohol is kept on the slide to prevent drying but not enough to allow the sections to float. When the requisite number have been arranged they are covered with a strip of toilet paper which is held on the slide by winding it with fine thread. The sections being thus firmly held in position may be stained, etc. They should not be placed in absolute alcohol but cleared from 95% in a mixture of equal parts of bergamot oil, cedar oil and carbolic acid. When cleared the excess of fluid is removed by a piece of blotting paper; with gentle pressure sections which are by chance loose are firmly fixed in position, the thread is now cut, the strip of paper rolled back, balsam and cover applied.

If the object can be stained *in toto*, which is often the case, much time may be saved by the following method: The stained object is imbedded in the usual manner, but after hardening in chloroform, and

removing the paper, the celloidin block is transferred to 95% alcohol for twenty-four hours, then to carbolic acid[1] or glycerin in which it becomes as transparent as glass[2]. The block is fixed in the usual manner.

Orientation is now accomplished with the greatest ease. In cutting, the knife is wet with the clearing medium given above. The sections may be arranged in serial order on the knife-blade until a slide-full is obtained, when they are transferred, balsam and cover applied. By this method long series may be readily handled. Glycerin is used only when the mounting medium is glycerin; in this case the knife is wet with glycerin.—A. C. EYCLESHYMER.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Boston Society of Natural History.—April 6th.—The following papers were read: Percival Lowell, Shinto Occultism, God-possession of the People; Harold C. Ernst, Some of the Advances in Bacteriology.—SAMUEL HENSHAW, *Secretary pro tempore.*

The Biological Society of Washington.—March 19th.—The principal paper of the evening was The Biological Basis of Psychology, by Prof. Lester F. Ward. The following communications were read: C. D. Walcott, On the Discovery of Certain Cambrian Fossils on the Coast of Massachusetts; F. H. Knowlton, The Fossil Flora of the Bozeman Coal Field; C. W. Stiles, Notes on Parasites. *Strongylus rubidus* Hassall and Stiles, '92.

April 2d.—The principal paper of the evening was The Interdependence of Plants and Insects, by Prof. C. V. Riley, illustrated by lantern slides. The following communications were made: C. Hart Merriam, The Distribution of Tree Yuccas, illustrated; H. E. Van Deman, Variations in the Fruit of *Hicoria Pecan;* C. W. Stiles, Notes on Parasites; Two Stages in the Life History of *Distoma magnum* Bassi 1875. (*D. americana* Hassall 1891.)—FREDERIC A. LUCAS, *Secretary.*

[1]Bumpus, (Am. Nat., Jan. 1892) advises the use of thymol.

[2]Since discovering this method of rendering celloidin blocks transparent which was published in the Bot. Gaz. 1890 I have found that the clearing mixture given above answers the same purpose as the carbolic acid but requires a little longer time.

SCIENTIFIC NEWS.

Sereno Watson.—On the 9th of March descriptive botany suffered a great loss in the death of Sereno Watson, for many years the Curator of the Gray Herbarium of Harvard University, and since Dr. Gray's death, the successor, and botanical executor of the kind-faced master. It was hoped that the work which Dr. Gray left unfinished would be completed by Dr. Watson, who was so well prepared to do it, but we are again left with the work incomplete. Torrey, Gray and Watson all worked along the same lines, and may be said to have maintained the same school of systematic botany. Had they completed the "Flora of North America," the impress of their ideas would have remained for all time. As it is, the fragments of the work will be gathered and arranged by other hands, and the thoughts of other men will be wrought into it.

Born in 1826 in East Windsor Hill, Conn., Dr. Watson was at the time of his death in his sixty-sixth year. He graduated from Yale in 1847, and subsequently taught school for a number of years, at one time being a tutor in Iowa College, then located at Davenport, Iowa. He studied medicine and was a practicing physician for a time in Illinois, abandoning this for other occupations. In 1867, when forty years of age he began his first botanical work in connection with the United States Geological Exploration of the Fortieth Parallel, under the charge of Clarence King. His report on botany in 1871 (vol. v. of the series) is a worthy monument to his descriptive ability, and at once gave him a prominent place in science. His labors since then have been unremitting. The two magnificent volumes of the "Botany of California" were largely his work. So too, the "Manual of Mosses" by Lesquereux and James, owes much to him. His "Bibliographical Index to North American Botany" will for many years to come stand as a monument to his industry, and he will long be remembered gratefully by many a botanist who finds here at a glance reference which would have taken many hours of searching.

In 1873 he began his series of "Contributions to American Botany" by the publication of a paper in the May number of this journal entitled "New Plants of Northern Arizona and the Region Adjacent." The "separates" were designated as No. I. of the series of contributions. No. III. also appeared in this journal (November, 1873), treat-

ing of the "Section Avicularia of the genus Polygonum." With the exception of No. VIII.—"The Poplars of North America"—published in the American Journal of Science and Arts, all other numbers were published in the Proceedings of the American Academy of Arts and Sciences. These reached to XVIII., which was issued July 31, 1891.

Personally Dr. Watson was a most genial man, full of a quiet cheerfulness, and good-fellowship which attracted those who knew him. His industry was comparable to that of his English counterpart George Bentham. The cheerful face, the pleasant voice, the quiet steady worker will be sadly missed from the ranks of American botanists.—CHARLES E. BESSEY.

A seaside laboratory of Natural History in connection with the Leland Stanford Jr. University, will be opened during the coming summer at Pacific Grove, California, on the Bay of Monterey about half way between Monterey and the Point of Pines. This laboratory will be for the purpose of investigations in the life-history of the marine animals and plants of this coast. It will be under the direction of Profs. Gilbert, Jenkins and Campbell of the chairs of zoology, physiology and botany respectively. It will be open to naturalists and others wishing to make special investigations in the anatomy or life-history of animals and to teachers of natural science. For further details those interested may apply to any of the directors at Palo Alto, Cal.

Mr. G. Pouchét gives in Revue Scientifique the following statement of reforms which he thinks should be introduced in the Museum and Jardin des Plantes of Paris.

The reforms which seem to be most urgent are as follows:

1. A more direct participation, more active and better conducted, by the official board of the Museum, both in its finances and its several departments.

2. The restriction of the optional positions to the newly appointed professors of natural history. The Ministerial Commission have hitherto jeered at this reform.

3. The participation of the professors of the Museum who are members of the Institute or doctors of science in the examinations for licentiate or doctorate of natural science.

4. The gradual suppression, or at least the transfer, to Vincennes of the menagerie.

5. The publication of an official bulletin instead of the costly *Annales*, which the Museum is reputed to publish.

6. The suppression of pensioned students and especially the residentiary canons.

7. Finally, the non-reëligibility of the director nominated for five years.

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HISTORY OF THE MOAS.

BY F. W. HUTTON.

The Moas belong to a group of birds called Ratitæ, to which also belong the Ostrich, the Rhea, the Emu, the Cassowary, and the Kiwi. They are all birds with rudimentary wings, soft fluffy feathers and adapted for terrestrial life. Professor T. J. Parker has conclusively proved that the Ratitæ are descended from flying birds. The structure of their diminutive wings and the cellular character of their bones are evidence that the ancestors of the Ratitæ could fly, but these flying ancestors must have lived a very long time ago, probably in the early part of the eocene period. That the Moas have been a long time in New Zealand is certain. In addition to the immense number of bones found in peat beds and river-alluvia of pleistocene age, remains have been found near Napier and probably also near Wanganui, which belong to the newer pliocene period. The bones of a small species of Moa, found two years ago under a lava stream at Timaru, are still older and probably upper miocene, while the Hon. W. Mantell found in 1849 a fragment of a bone, which probably belonged to a Moa, near Moeraki in beds of lower miocene age.

The Ratitæ are generally supposed to have originated in the Northern Hemisphere, and to have spread southwards into Patagonia, South Africa, Australia and New Zealand. But if so, how could birds which could not fly manage to reach New

Zealand without being accompanied by any Mammalia? Certainly they did not precede the Mammalia, and it is very unlikely that they should twice have swum across straits which were impassable to mammals—once from the Oriental into the Australian region, and again from the Australian region into New Zealand—and there are other reasons for doubting the northern origin of the Australasian Ratitæ. The New Zealand Ratitæ are smaller than any of the others, and make a nearer approach to the original flying ancestors; and we should expect to find the smallest and least altered forms near the place of origin. Now there are in Central and South America a group of birds called Tinamous, which, although flying birds, have been shown by the late Professor W. K. Parker to resemble the Australasian Ratitæ in many particulars, and as the connection between South America and New Zealand is well known, it seems more probable that the Moas originated in New Zealand in the eocene period, from flying birds related to the Tinamous, and that they spread from here into Australia and New Guinea, than that they should have migrated southward from Asia.

In whatever way the Moas originated in New Zealand, it is evident that the land was a favorable one, for they multiplied enormously and spread from one end to the other. Not only was the number of individuals very large, but they belonged to no less than seven genera, containing twenty-five different species, a remarkable fact which is unparalleled in any other part of the world. Africa and Arabia are inhabited by but two or three species of ostrich; South America from Peru to Patagonia, has only three species of Rhea; Australia has two species of Emu and one Cassowary; while eight other species of Cassowary inhabit islands from New Britain to Ceram. Outside New Zealand two species of Ratitæ are rarely found living in the same district while a few hundred years ago there were in New Zealand several different kinds of Kiwi as well as the twenty-five species of Moas. An explanation of this problem may perhaps be found by examining the present distribution of the Cassowaries. Here we have eight species inhabiting five different islands, and if this region of the earth were to be

elevated, and the islands joined together, these eight species would mingle. If the region were to sink once more all of them would be driven to the highest land, and might all be crowded into one small island. Now we know, from geology, that New Zealand has gone through a series of changes in level, similar to those just mentioned. In the miocene period it consisted of a cluster of several islands, which were elevated and united in the older pliocene, and ultimately divided into the two islands we have now in the newer pliocene. If the ancestors of the Moas inhabited New Zealand during the eocene period they must have been separated on these islands during the whole of the miocene, and mingled together again in the pliocene. In this way—*i.e.*, by isolation—probably the genera originated, but the species appear to be due to variation without isolation. As is the case with most common animals, the Moas varied greatly and, there being no carnivorous mammals to hold them in check, while vegetable food was abundant, natural selection did not come into play, and the intermediate forms were not strictly eliminated. Under such favorable circumstances the conditions of life were easy, and the birds got larger and fatter, more sluggish and more stupid. The oldest known Moa is one of the smallest, and it is the smaller species which are found in both islands; from which we may infer that they were the only ones in existence when the two islands were united, and that the Moas since then increased in size. But the very large Moas were always comparatively rare. The commonest kinds in the North Islands were only from two and a half to four feet high, while those of the South Island were mostly from four to six feet in height. The giant forms, going up twelve and thirteen feet, were seldom seen.

Throughout the pliocene period the Moas flourished greatly; but in the pleistocene they must, in the South Island, have died in large numbers, for how else could such immense quantities of bones have come together in the peat-beds at Glenmark and at Hamilton in Central Otago. It has often been suggested that flocks of birds, attempting to escape from fires, rushed into the swamps and perished. But when we remember

that these Moas died thousand of years ago, long before there were any human inhabitants to light fires, it will be seen that this surmise is quite out of the question. Only two hypotheses appear to be possible to account for the facts. Either the birds walked into the swamp and were drowned or else their dead bodies were washed in. The first hypotheses is probably the explanation of the deposit at Te Aute near Napier, because many of the leg bones were found upright in their natural position. But at Glenmark and at Hamilton the bones were lying in all directions, as often upside down as in any other position, and the peat-beds were only a few feet thick, and filled with bones up to the very top. We cannot, therefore, suppose that these Moas were swamped, and there is evidence in both of these cases to show that the dead bodies of birds were washed in by floods. We find corroborative evidence of this in the alluvial plains of Central Otago, for these always contain numerous bones wherever a stream enters them from the hills.

But how are we to account for the number of dead birds washed down from the hills? There are two remarkable facts connected with these bone deposits at Hamilton and Glenmark. One is the very large proportion of bones of young birds from one-half to three-quarters grown; and the other is the absence of Moa egg shells. These two facts seem to show that the birds perished in the autumn or winter, when the birds of the year were not full grown, and when the females did not contain any hardened eggs. Also, it is evident that dead Moas could not be washed into swamps under the present climatic conditions, and the explanations of the puzzle must lie in the fact that in pleistocene times, when these bone deposits were formed, the climate was very different from what it is now. At that time the eccentricity of the earth's orbit was very great, and when winter in the Southern Hemisphere happened in aphelion, long cold winters were followed by short and very hot summers. It seems probable therefore, that the early winter snows killed large numbers of Moas and other birds on the hills, that their bodies were floated down by summer floods and avalanches caused by the melting snow,

and that they were deposited in hollows at the foot of the hills. As the pleistocene period passed away the climate became more equable and the surviving Moas once more increased and multiplied, until they were ultimately exterminated by the hand of man.

All are now agreed that the Moas were exterminated by the ancestors of the Maoris, and the only question upon which opinion is still divided is, How long ago was this? The case seems to me to stand thus. In the North Island there are several names of places in which the Moa is incorporated, but in the great number of Maori tales and poems which have been collected by Europeans the allusions to the bird are very slight and obscure, generally, indeed, fabulous. There is also one very ancient poem called "The Lament of Ikaherengatu." in which the pharse "Ka ngaro i te ngaro a tea Moa" (lost as the Moa is lost) occurs, which certainly shows that the bird was not in existence when the poem was composed. The so-called traditions of its habits appear to be, in large part at least, late deductions from these words and phrases, and we must conconclude that in the North Island, the Moa was exterminated by the Maoris soon after their arrival in New Zealand; that is not less than 400 or 500 years ago.

In the South Island there are no names of places containing the word Moa, but here remains have been found—either skeletons lying on the surface or bones with skin and ligaments still attached—which give the impression that the birds were living here not more than ten or twelve years ago. Now the bones which are said to have strewn the surface so abundantly when the first settlers came, had all disappeared in fifteen years; so it is plain that either some change in the surrounding conditions cause the bones to decay, or that none of the bones which were so abundant in 1861, were more than fifteen years old. But as we cannot believe that Moas were abundant in Otago in 1846, we must fall back on the opinion that the fires lighted by the early settlers to clear the scrub so altered the conditions under which the bones had been preserved that they soon decayed, in which case we cannot say how long the bones may have been lying there. It is some-

thing the same with those bones which still have dried skin and ligaments attached. They are so fresh that, unless the birds lived a few years ago, they must have been preserved under specially favorable conditions; and there are reasons for thinking that the small district of Central Otago, in which alone these remains have been found, is one specially favorable for preserving animal remains. If this be so we cannot say for how many years they may have been preserved, perhaps for centuries, and as we have every reason to believe, upon the authority of the Rev. J. W. Stack, that the ancestors of the Ngai Tahu, who have inhabited the South Island for the last 200 or 250 years, never had any personal knowledge of the birds, we must allow that the Moa has been extinct for at least that time. On the other hand, it is quite certain that the Moa was exterminated by the Maoris, and the Maoris are not supposed to have inhabited the South Island for more than 500 years, so that the time of extinction must fall between these dates. It seems improbable that the Ngatimamoe, the last remnant of whom inhabited the West Coast sounds a few years ago, were Moa hunters. The moa hunters of the South Island were not cannibals, and as Te-rapu-wai and Waitaha, the tribes who preceded the Ngatimamoe, are said to have been peaceful and to have "covered the land like ants," it lends support to the Maori tradition that it was they who exterminated the Moa and made the shell heaps on the beach. If this be so the Moas were exterminated in the South Island about 300 or 400 years ago; that is, about a hundred years later than in the North Island.—*New Zealand Journal.*

EXPERIMENTAL EMBRYOLOGY.

By E. A. Andrews.

The accumulation of embryological facts and their application to problems of animal morphology from the days of von Baer to the period of Balfour's text book of Comparative Embryology was carried on with ever increasing speed culminating in the present day when the revision of Balfour's work by Korschelt and Heider assumes such unexpected proportions. Though the advance of descriptive embryology has been so great, the physiological aspects of the subject have been but little cultivated, partly to be sure, from the necessary dependence of such work upon the anatomical facts that were not at first available. Now, however, when the normal development is known for all groups of animals and comparative embryology stands upon a firm basis, the application of physiological methods, the introduction of experimentation into a field promising much richer harvest than the study of adults can hope to yield, may be no longer delayed. Knowing the changes of form that ova pass through to attain the adult condition may we not both eliminate such changes as are unessential and also press nearer to the solution of more fundamental questions by varying the condition of environment and the physical state of the ovum or embryo?

Interference with the normal course of embryological phenomena was no doubt often brought about more or less unconsciously, or at least incidentally, by many of the older embryologists and remarkable results sometimes attained. Only, however, within the present decade have systematic researches been begun, definite and thought-out experiments devised and finally predictable results attained by workers in the domain of what may be called experimental embryology, though as yet the methods and the subject matter are so differently conceived by various authors and the question involved so overlaps the regions assigned to other branches of Biology that the term has at best but a vague and changing significance.

Some of the researches in this subject seem to be of such interest, though but beginnings and liable to be wrongly valued one way or the other, that a review of them here may aid in calling attention to a comparatively new line of research, one that is as yet in the limbo of pathology and thus excluded from zoological and embryological text books.

Passing over numerous experimental investigations upon the hen's egg, some of which appear to have resulted in the formation of definite, predictable monstrosities from localized interference with the embryo, we will mention only the work of Leo Gerlack[1] who finally devised a movable window, embryoscope, that allows the chick to be observed and also experimented upon from time to time while continuing to live, at least for 13 days.

With the aid of this instrument embryological problems such as the origin of the vascular system from parablast or from the primitive streak may be approached experimentally, by destroying the primitive streak for instance. By similar methods the author hopes to produce changes in embryos of several successive generations and thus strive towards the selection of important questions in heredity.

It is the frog, however, rather than the chick which has given more decided answers to physiological inquiry promising to be in its early stages what it has become as adult, an easily accessible and not so excessively equivocable an oracle.

Professor Pflüger,[2] starting from the observed facts that frogs' eggs taken from the uterus and thrown into water, float at first with variously inclined axes but after fertilization turn so that the black pole is uppermost and the white pole downward and that when cleavage takes place the first and second planes are vertical, the third horizontal was led to inquire what connection there may be between cleavage planes and gravitation.

The method of investigation was simply to remove ovarian eggs with their gelatinous capsules and fix them by their own

[1]Leo Gerlack: Ueber neuere Methoden auf dem Gebiete der experimentallen Embryologie. Biol. Centb. 7, 1888, pp. 587–605.

[2]E. Pflüger: Ueber den Einfluss der Schwerkraft auf die Theilung der Zellen. Archiv. f. Phys., 31, 1883, pp. 311–318.

viscosity upon glass plates with the white ends upward; then fertilize them artificially by sperm in so little water that the jelly does not change sufficiently to allow the egg to rotate as it normally would, but keeps it with the white side upward. In such inverted eggs cleavage takes place: moreover the first and second plane are vertical, the third often abnormal, often at right angles to the other two.

This is true when the egg is much inclined or even horizontal, that is when the egg axis, or line joining the centers of the black and the white regions, is turned out of the vertical and the first and second plane no longer intersect at this line as they normally would. Later the neural folds often appear upon the upturned white pole and throughout this pole cleaves more rapidly than the lower pole, as is the case in a normal egg with black pole uppermost.

An entirely different problem was also solved by the same method. Seventeen eggs fixed in normal positions and kept three days till the neural groove and ridges were formed, gave the direction of the median plane of the future frogs. The plane of the first cleavage furrow having been previously indicated by lines on the glass the eggs were stuck to, it was found that in twelve cases the median plane of the animal coincided with the first cleavage plane, in four it made an angle of 30°–60° and in one an angle of 90°.

To return to the effects of gravitation: it seems from a second paper[3] that normal larvæ both of *Rana esculenta* and of *Bombinator igneus* were raised from eggs held inverted as well as some larvæ partly white on the dorsal surface and not normal enough to live long.

The medullary folds, normally upon the black pole, may be made to appear upon the white pole by inclining the egg axis. The author concludes that the egg is directed by gravity so that cleavage may take place in various planes of the egg according to the position of its axis with reference to the lines of gravitation or vertical plane. Moreover, these effects are seen later, the author thinks, in the origin of the blastopore

[3]E. Pflüger: Ueber den Einfluss der Schwere auf die Theilung der Zellen und auf die Entwicklung des Embryo. Archiv. f. Phys., 32, 1883, p. 1–77. Pl. 1–2.

just ventral to the equator of the egg. Normally the blastopore appears just ventral to the equator and passes, so Pflüger maintained, across the white pole to the opposite side of the equatorial region. In unusual positions the blastopore also appears just beneath the horizontal equator, whatever part of the egg this equator may be in the given inclined position.

Pflüger came thus to regard the essential elements of an egg as having no more prearranged relationship in position to the part of the future embryo than do "snowflakes to the avalanche they may give rise to." Gravity acting to arrange the parts of an egg according to circumstances, much as snowflakes may be collected by gravity to form an avalanche, under certain circumstances.

The fundamental character of these experiments seems to be upheld by the fact presented in a third paper[4] that eggs thus held in oblique positions actually developed as far as the adult shape, quite normal toads being reared from eggs of *Bombinater igneus.*

Moreover other forces than gravitation act in the same directive fashion upon the cleavage, for Pflüger mentions his repetition of certain experiments of Rauber upon trout eggs, using eggs of both *Rana* and *Bombinator* and finding that in a rotating machine the centrifugal force controlled the appearance of cleavage planes.

Frog's eggs compressed between vertical plates of glass cleave at right angles to the plates and generally in the vertical plane also, but in exceptional cases at all angles to the vertical plane: here pressure is assumed as a sufficient determining influence.

The frog's egg is thus regarded as directly influenced by external forces and fundamentally altered in the arrangements of its constituents. The egg is like a mass of porridge with its outer part firmer and its main mass perhaps traversed by some reticulum of firmer material, but still so mobile that the heavier yolk can sink to the bottom and the less heavy remain above it, much as sediment falling in a liquid.

[4]E. Pflüger: Ueber die Einwirkung der Schwerkraft und anderer Bedingungen auf die Richtung der Zelltheilung. Archiv. f. Phys., 34, 1884, pp. 607–616.

That this conception of the egg does not fulfil all the requirements might have been argued from the statement of Pflüger himself that the eggs experimented upon successfully, were inclined, but if placed exactly inverted with only the white pole upward, failed to develop.

It remained for Born[5] to show in what sense gravitation may be said to have anything to do with the direction of the cleavage plane and how the development of neural ridges upon what was the white pole can be brought about without there being any interchange of function between the normal neural side of the egg and the abneural white side.

Eggs fastened in an inclined position with the white showing become grey in from three quarters of an hour to two hours after fertilization. This change in appearance is due to an actual rearrangement of material beneath the firmer superficial layer of the egg, white or dark on opposite poles. The dark colored material of the egg is not confined to the surface of the dark pole, but there penetrates far towards the center in a symmetrical mass enclosing some light yolk near the center of the dark pole.

When the egg is inclined this darker material rises upward along one side of the sphere, carrying the enclosed white yolk with it, while the heavier white yolk flows down on the other side of the sphere from its forced position to a more normal one. Thus the material normally at the upper pole is brought there again, though covered over still by some superficial white yolk that remains over the white pole, now become grey.

When this rearrangement takes place at so late a stage that the nucleus is dividing as it rises, then the first plane is not necessarily vertical; gravitation acting only indirectly, while other causes determine the direction of the first cleavage plane.

Roux[6] had drawn the same inference as to the insignifi-

[5]C. Born: Biologische Untersuchungen. I. Ueber den Einfluss der Schwere auf das Froschei. Archiv. f. Mik. Anat., 24, 1885, pp. 475–540. Pl. 23–24.

[6]W. Roux: Beiträge zur embryonal Entwicklungsmechanik. 2. Ueber die Entwicklung der Froscheier bei Aufhebung der richtenden Wirkung der Schwere. Bresl. Arz. Zeit., 1884, No. 6.

cance of gravity as well as light, heat, magnetism in directing the cleavage processes from rotation experiment upon frogs' eggs. Using a vertical wheel, revolving rapidly enough to produce centrifugal effect, about double that of gravitation, he found the eggs develop normally, though constantly presenting their white poles away from the centre of the wheel and being thus acted upon alternately above and below, by gravitation. Having eliminated the constant action of gravity as a directive force, he concluded it was unnecessary for the appearance of cleavage planes and assigned this to causes within the egg.

By numerous other contributions and complete devotion to a definite line of embryological research, this author has become as it were, the apostle of a new branch of embryology, *Entwicklungsmechanik.* Judging from the heterogenous character of the 262, 384, and 277 works for 1887, '88, '89, ranged under the above heading, as forming a separate department in Hermann and Schwalbe's *Jahresberichte* we conclude that this term is by no means synonymous with physiological or with experimental embryology, but has a much wider application, including the last as one of its subdivisions.

The first definite use of the term together with outlines of the problems to be attempted in this pre-determined field of work was made by Roux in 1885[7]. We there find *Entwicklungsmechanik* to be the science of the character and action of the combinations of energy which produce development. Also, development being the origin of observable multiplicity, there may be either read production of or merely transformation of non-observed into observable manifoldness. Epigenesis is then the actual creation of complexity: Evolution only the sensualization of latent diversities.

The key to the causal knowlege of development lies in the determination of the relative value of two possibilities: self-differentiation: interaction with the environment. Self-differentiation of a system of part is the result of the energy of the system itself. Correlative differentiation is the change of a

[7]W. Roux: Beiträge zur Entwicklungsmechanik des Embryo. Zeit. f. Biologie, 21, 1885, pp. 411–524.

system from loss or advent of energy from without, provided these changes are specially determined by this outside energy.

To determine what external forces might be at play in embryological phenomena he had thrust large pins into frog larvæ, fastening them to wax under water, in the expectation that any electrical condition of the surface would be changed by the addition of a good conductor. As some of the tadpoles developed normally he inferred the electrical state of the surface of the body was not a determining cause in the processes of growth. In this work he found certain abnormal changes in the surface cells when death took place and subsequently made use of these as a means of determining the condition of cells in early stages where there were no movements. The chief result appears, however, to have been the suggestion of a method afterwards very extensively employed.

Thus as early as 1882 he thrust needles into frogs' eggs to see if the protoplasm were arranged corresponding to the future differentiations, though recognizing the roughness of such attempts which he likens to the casting of a bomb into a factory, in hopes of drawing conclusions from the resulting changes in productivity, as to the character of damage inflicted.

On withdrawing the needle point from an egg a mass of black, or black and white yolk exudes at once and may afterwards be increased. This *extraovate* either remains connected with the wound by a narrow stalk or else separates and leaves no discoverable trace of the wounded spot. In extreme cases, one-fourth to one-fifth of the bulk of the egg may be thus lost, yet development may proceed.

Regarding the effects of wounding we find, in general, a large number of eggs develop normally, though many embryos formed are weak and small, but there are many abnormalities, some of which are like those often met with in eggs not operated upon, while others are rarely if ever found in nature. Operation at different stages produces results as follows:

Injured before cleavage had begun the eggs developed abnormally in many cases, forming larvæ with deformed

heads, absent medullary folds, etc. After the first cleavage the second plane often passes through the wound and after the second cleavage one plane sometimes changed so as to pass through the wound now made. The resulting embryos often have circumscribed areas of deficient development. When injured after the equatorial plane was formed normal tadpoles were found amidst abnormal ones.

Operations after the fourth, fifth and sixth planes have appeared show that injury to the black pole produces defects in the region of the medullary folds. Blastulæ injured nineteen hours after fertilization show fewer cases of circumscribed defects. In addition it is to be noted that the exuded part of the egg may undergo by itself, a sort of cleavage resulting in the formation of a mass of numerous cells.

It thus appears that all the material of an egg is not necessary to form a normally shaped embryo: that rough mechanical disturbance of the egg material does not produce complete irregularity in the subsequent arrangements of organs: that circumscribed injuries often produce circumscribed defects and that about the same effect results whatever stage of cleavage is injured.

The author, however, does not know why the defects are sometimes absent, nor can he produce the same defect at pleasure, in different experiments. Yet the methods of injuring definite areas of the egg is made use of in referring the cleavage planes to the axes of the subsequent embryo. Thus when eggs in the two celled stage have the needle thrust into them in the black pole, at the uppermost part of the border between black and white, the egg being naturally inclined, a circumscribed defect appears posterior to the middle of the medullary folds, whence we see that the posterior part of the medullary folds were formed over what was the white pole and the third plane divides head from tail substance.

But this question of axes and position of embryo will be dealt with later on in connection with other experiments.

The gastrula also was injured by the needle, but with conflicting results as to the circumscribed nature of the resulting defects. Deep cuts made into the gastrula yield the interesting

result that each newly severed part may form its portion of the medullary fold separately. Development continued even when large tongue-shaped pieces were completely cut out. When the medullary fold region is cut lengthwise, a double-tailed monster was sometimes formed.

Larvæ with the medullary folds formed, completely cut into two, regenerate to the slight extent that an epithelial border may be formed around the rim of the wound. When cuts are made upon the ventral side the wound may heal over completely.

In all the gastrulæ and later stages the wounds led to little loss of material unless continued into the yolk mass. No subsequents defects in ectoderm were found, the wound healing over or remaining open with no formation of new ectoderm from the underlying layer. When life continued, the development was often normal though tumors were found in some cases.

Roux sees in many of the above experiments evidence for the importance of self differentiation as a principle in embryology, and also emphasizes the self regulation there observed as the most essential common character of organisms.

The interaction of the various parts of an embryo may fall under various heads not understood, but there are three chief methods insisted upon by Roux. These are functional adaptation, struggle of organs, and mechanical mass correlation.

This last factor was emphasized by Prof. His who laid stress upon the elasticity of the germ layers as an agent in bringing about folding, etc. Roux has, however, made experiments that tend to limit the application of this principle. Thus frog embryos cut into pieces showed no bending as would have resulted if there had been a tension of the surfaces. Again in a chick forty hours old the removal from yolk did not cause any gaping open of the medullary folds such as would be expected if lateral pressure had brought them about: in fact a younger embryo proceeded to form its folds even after removal, by self differentiation not by mass correlation evidently.

Then His' derivation of the the fourth ventricle from a bending of the brain, is not supported by experiments upon frogs and chicks in which, to be sure, a ventricle-like fold was produced by actual bending; but this was not in the position of the fourth ventricle and was, moreover, the result of the reaction of the living substances, not simply mass correlation.

An ingenious research into the cause determining the direction of the first cleavage plane in the egg and hence the median plane of the adult frog, as it is thought, was subsequently published in full by Roux[8] in 1887.

The method employed was simply to place eggs from the oviduct upon glass, white pole downward and allow them to adhere. Then sperm was added either by touching a cut made in the jelly with a brush moistened by sperm or else by introducing sperm through a capillary tube into one point of the jelly. Examined at frequent intervals the appearance of the cleavage planes was noted and referred to marks made upon the glass or paper under egg.

When the eggs were fastened in the normal position and were not eggs laid late in the season, when abnormalities are frequent, the following results were obtained:

Before fertilization but one axis of the embryo is indicated in the egg: the main axis of egg, that from black to white pole representing the ventro-dorsal axis of the actual embryo, which the author believes has its neural folds formed upon the white pole when held in a normal position. Yet this axis corresponds to a cephalo-caudal direction of the embryo when we consider the rearrangement of material that takes place during gastrulation. Of the infinite planes passing through this axis that one becomes the median plane of the frog which is determined by the plane of copulation of the male and female pronuclei. This plane of copulation in turn is not predetermined but may be put in any meridian by localized fertilization.

The side selected for entrance of sperm becomes the ventro-

[8]W. Roux: Beiträge zur Entwicklungs mechanik des Embryo. IV. Die Richtungs-bestimmung der Medianebene des Froschembryo durch die Copulation richtung des Eikerns und des Spermakerns. Archiv. f. Mik. Anat., 29, 1887, pp. 157–211. Pl. X.

PLATE XV.

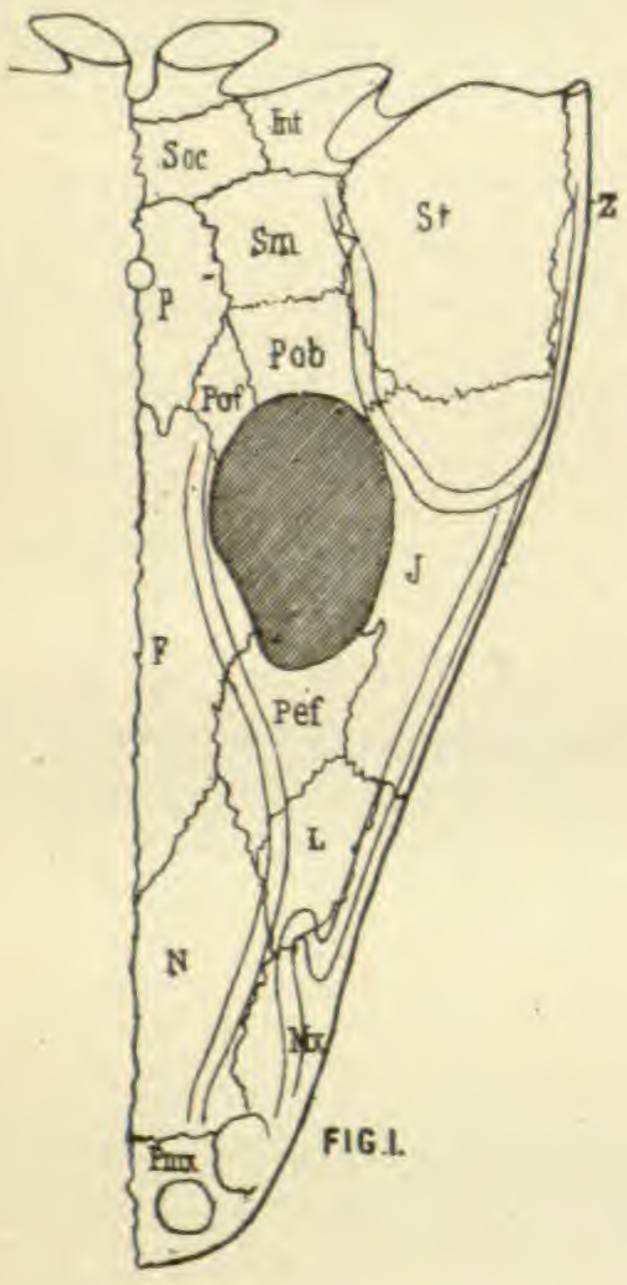


FIG. 1.

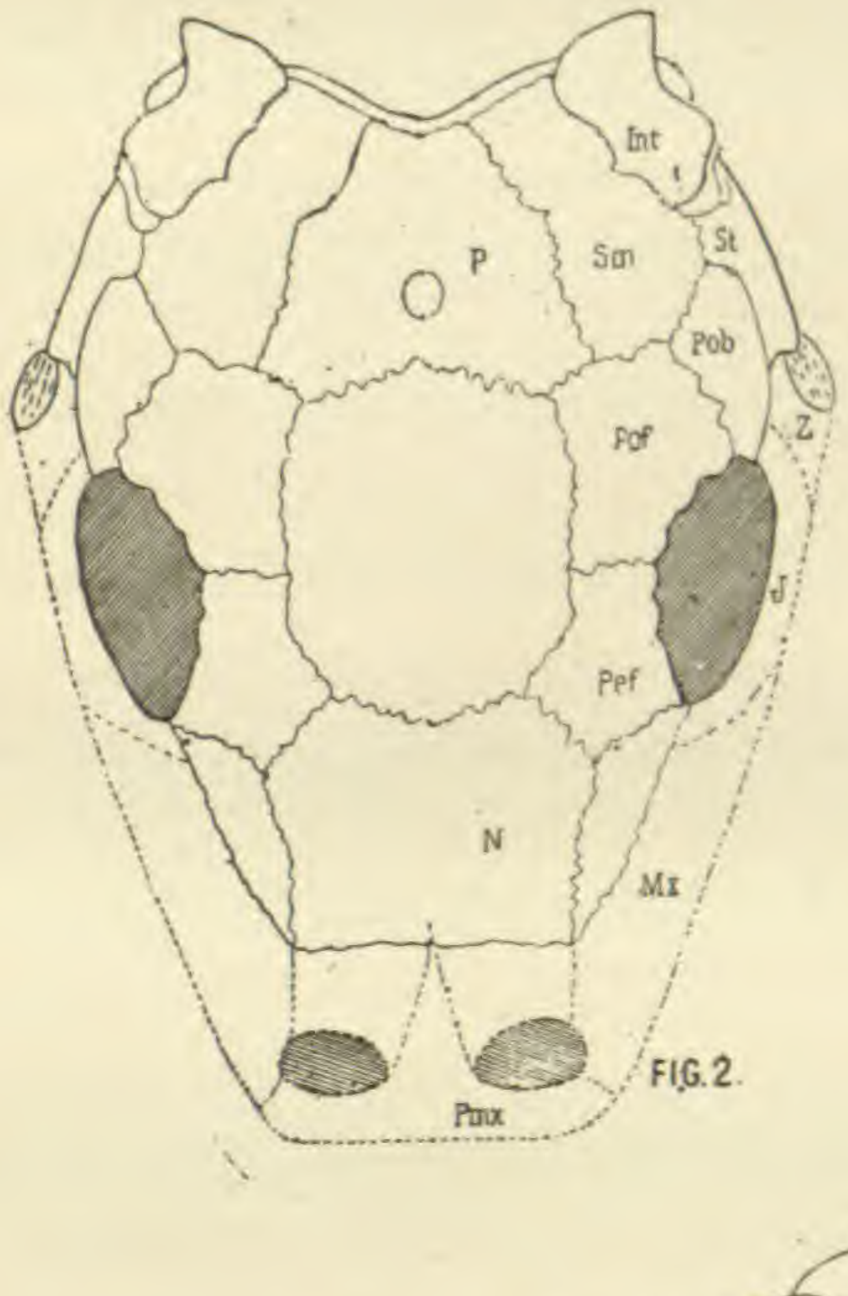
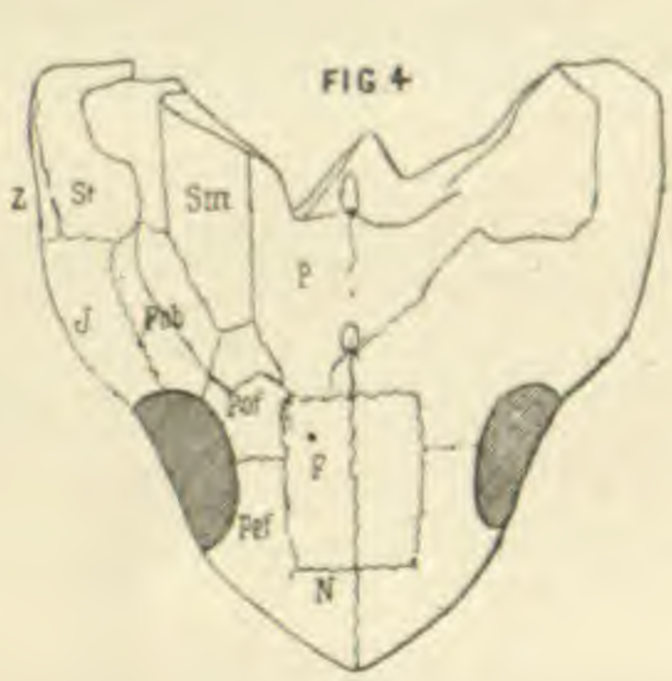


FIG. 2.



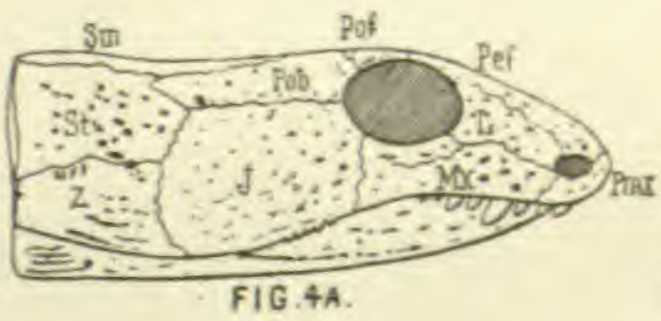


FIG. 4A.

FIG. 3.

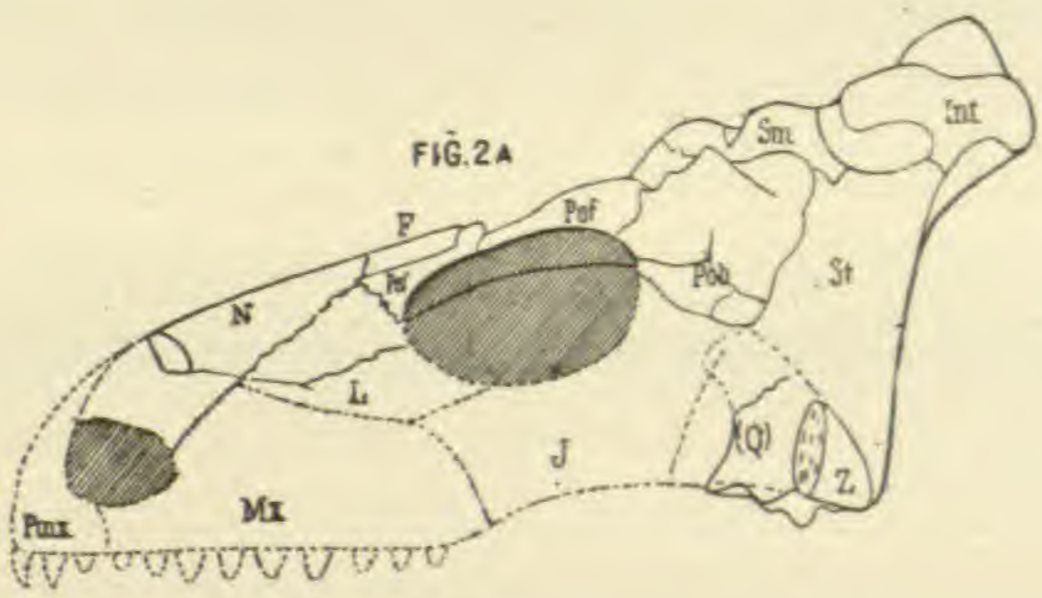


FIG. 2A.

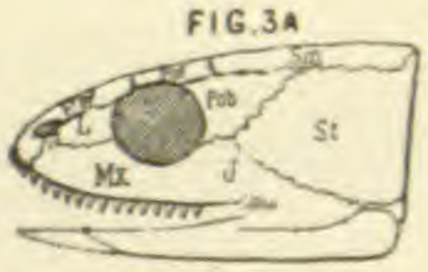


FIG. 3A.

1. *Mastodonsaurus* Jaeger. 2. *Chilonyx* Cope. 3. *Pariotichus* Cope.
4. *Pantylus* Cope.

caudal and the opposite the dorso-cephalic side of the embryo. An examination of these eggs by sections shows that the course of the sperm as indicated by the trail of dark pigment left behind it is first a long radiating line from the black pole near the white rim to a layer deep within the egg in which the copulation of nuclei takes place, then a short course towards the female nucleus.

The author then points out that the cleavage in the plane of copulation ensures an easy separation of the material of both pronuclei, provided they are not intermixed in copulation, half of each being readily moved into each of the resulting cells.

When, however, the eggs are held inclined more than 20°–30° the above rules do not hold good. Though even here the first cleavage seems to coincide with the plane of copulation of nuclei, yet these are often at right angles to the future median plane of the frog, though they may coincide with it in some cases. This is to be explained on the assumption that gravity acting upon yolk and nuclei determines a rotation of copulation direction.

Again in these much inclined eggs the lowest side of the black pole becomes the ventro-caudal part of the embryo, possibly because the formative yolk may accumulate there and influence the nuclear cleavage.

The most interesting of Roux's contributions appeared a year later.[9] In this he follows out the question of self-differentiation of the embryo, seeking to determine the amount and character of interaction of the part of an egg by destroying or injuring definite cells during cleavage. The eggs of *Rana esculenta* in the two celled stage were at first simply stabbed by a fine sharp needle, thrust into one cell, but as this did not produce much injury the needle was heated and often moved about inside the cell. Of such eggs about 20 per cent. developed only from the uninjured cell, others went to pieces or else developed normally. It is to be noted also that at this

[9] V. Beiträge zur Entwicklungsmechanik des Embryo. Ueber die kunstliche Hervorbringung halber Embryonen durch Zerstörung einer der beiden ersten Furchungs-kugeln, sowie über die Nachentwicklung der fehlenden Körper-hälfte. Virchow's Archiv., 114, pp. 113–153, 246–291. Pl. 2–3.

time of year, the latter part of the spawning season, some similar abnormalities were found in eggs that had not been operated upon at all. The various stages of abnormal growth were hardened, stained and sectioned. The results of such injury may be considered, first as relates to the uninjured and then to the injured half of the two celled stage.

The single cell by side of the injured one develops in many cases into a half embryo, first a half blastula, a half gastrula then a half embryo with medullary fold, archenteron, chorda, mesoblast and metameres representing only half of the normal condition of these organs.

In the four-celled stage injury to both posterior cells sometimes resulted in formation of only anterior half of medullary folds. Injury to three or to one of the cells resulted either in one-fourth blastulæ or in the other cases three-fourths embryos. Finally injury above or below the first horizontal furrow gave rise to some cases of upper half blastulæ.

He concludes that as each of the first two cells may develop up to stage of medullary folds without aid from the other, there is marked self-differentiation and that the cleavage planes separate the material qualitatively and thus determine the subsequent position of the organs. The last experiment also indicates that the gastrula or embryo is a mosaic made up of at least four vertical elements or independent parts.

Turning now to the complex phenomena that take place in the cell operated upon, regarded by Roux as dead, though evidently this is scarcely justifiable from its subsequent history we find three series of events taking place: 1st disintegration, 2nd reorganization, 3d post generation.

In the first category are included, a vacuolation of the yolk, the appearance of a net work within it in places and the formation of peculiar bodies regarded as nuclei derived from the original nucleus of the operated cell. Here again we must not overlook the fact that some eggs found at this season do not develop but have similar abnormal nuclei. Only about one-third of the eggs operated upon and subsequently sectioned present these phenomena of disintegration.

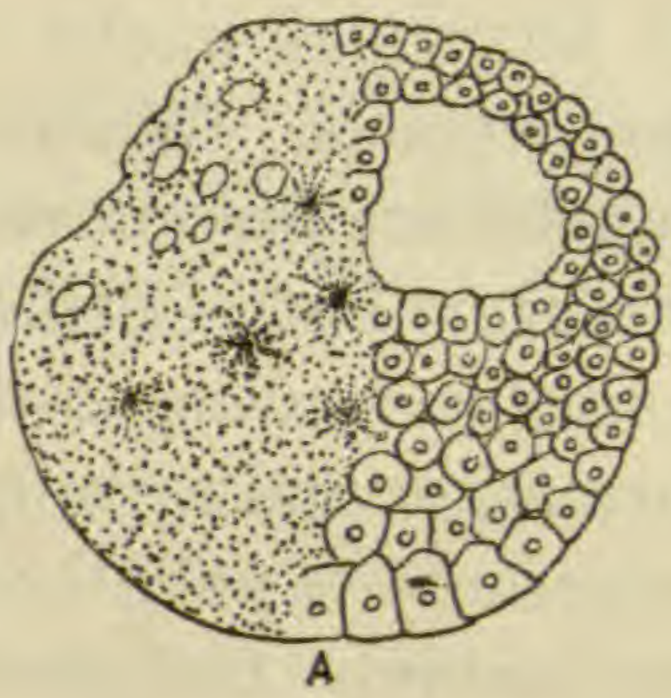
In all the operated eggs there are normal nuclei present in the half that was injured and these come in part from the original nuclei and in part by migration from the uninjured half, at least so the author concludes. These normal nuclei undergo further development and are associated with cell walls in the process of reorganization, the abnormal nuclei on the other hand collect in clusters and go to pieces. Where these abnormal nuclei and the vaculated nuclei are present reorganization of the yolk is delayed for some time but elsewhere the yolk presents rearrangement of its granules leading to the formation of cell walls. Besides the formation and arrangement of normal nuclei and the reconstruction of the yolk there is a third process in the reorganizations, namely the growth of cells from the uninjured half over the injured half or at least over such parts of it as present vaculated yolk. All three processes may take place at once or separately.

Post generation is the completion of the half of the embryo in which the above nuclear changes have regenerated the mass apparently killed by the injury of operation. It is externally manifested by the formation of a layer of pigmented cells over the operated half, the formation of the missing medullary fold which grows from before backward or of the posterior parts of both folds when we have an anterior half embryo. The complete tadpoles resulting are in part active, in part weak, easily killed creatures.

The internal changes that take place in this post generation as revealed by sections are the growth of a new ectoblast and mesoblast into the previously imperfect cellular mass by a process of successive rearrangement and differentiation of the yolk cells, adding themselves to the edges of the advancing layers in such wise as to form parts symmetrical with those in the uninjured half of the embryo. The entoblast also is formed from the free edge of the entoblast of the perfect half by rearrangement of yolk cells and there is no invagination, no gastrula nor blastula cavity formed in this newly forming half of the embryo. The germ layers thus form by a sort of regeneration from the interrupted surfaces of the old germ layers, but as the material comes from the new half of the

embryo the old half may be regarded as exercising a sort of formative or assimilative action upon the irregular mass of yolk cells in the new half.

FIGURE 1.



A

B

C

To recapitulate the chief results with the aid of fig. 1, A, B, C: A, being a half blastula resulting from injury of one of the first two cleavage cells and as yet not reorganized, seen in section: B, a right half larva from dorsal view and C are anterior-half larva. Injury to one of the first cleavage cells may result in the formation of a half embryo, to one of the first four to a fourth embryo, to three of the first four to a three-fourths embryo. The dead cells (regarded as dead by the author) may be revived and reorganized partly by division of the nucleus present and partly by inwandering of new nuclei and their division. The nucleation is followed by a cellulation and this by a regeneration of germ layers not following the normal course but growing out from the exposed surfaces of the layers already formed in the other half of the embryo. This definite process of post-generation seems due to the controlling action of the formed germ layers upon nuclei and yolk collected by chance in the places they occupy before being thus incorporated with the germ layers. Thus the reorganized parts are not capable of self differentiation as are the early cells in cleavage but are dependent upon influences coming from the other half of the egg or embryo.

An earlier paper by the same author, Roux,[1] has led to inter-

[1]W. Roux: II Beiträge zur Entwicklungsmechanik des Embryo. 3 Ueber die Bestimmung der Haupt-richtung des Froschembryo im Ei und die erste Theilung des Froscheies.

Breslauer arztliche Zeitschrift, 7, 1885. 1. nrs, 64–68, 73–77, 87–88, 100–101, 112–116, 125–128.

esting facts and discussions regarding the axial relations of egg and embryo in the frog. In these experiments the eggs were put into semen for four minutes, then provided with a hair inserted into the gelatinous envelop as an index of movement and floated in a solution of gum arabic contained in a vessel of mercury that thus enabled one to see the reflected image of the under side of the egg. The eggs now take up a definite inclined position but subsequently, in 13 to 30 minutes change so as to stand vertically. Control experiments with eggs not fertilized show that the change in position does not take place as a rule. Hence fertilization is regarded as bringing about an alteration in the egg axes with reference to the lines of gravitation. The first cleavage plane would then pass through the egg in its secondary position which has been brought about by the entrance of the sperm. This led to the experiments previously reviewed, on the determination of the first plane by the plane of copulation of the nuclei.

The validity of conclusions drawn from observations upon eggs in gum solutions is obviously, as Schultze has pointed out, very doubtful, especially when we find that of 47 eggs only 8 formed even the first cleavage plane and the inclination of these eight eggs in the gum was so obviously influenced by it, being 90°, 60°, 50°, 50°, 30°, 20°, 20°, 20°.

In another part of this paper it is found that frogs' eggs drawn out to double their normal diameter in narrow glass tubes assume a conical or else a lens shape, but cleave and at first transverse or at right angles to the tube, in the line of pressure. Again eggs in larger tubes wound about by wire through which an electric current was passing show no difference from the normal cleavage. The same is true when the eggs are between the poles of a magnet. Incidentally it was found that the eggs left in the tube did not continue development unless close to the air, at ends of tube or next bubbles, the position of organs formed or at least the gastrula mouth has, however, no reference to the side whence the air supply came.

With Pflüger, Roux finds the first cleavage plane is the median plane of the frog, yet not without exceptions since the normal sequence may be interrupted and the first plane act-

ually found separate the anterior from the posterior part and thus represent the normal second plane. Rauber[2] it is to be noted, found somewhat similar irregularities. Thus in the frog the first plaue in seven eggs made the following angles with the future median plane of the adult, 90°, 50°, 90, 85°, 0°, 82°, 90°. In the axolotl the same angles were, 80°, 53°, 90°, 50°, 90°, 30°, 90°, 2°, 90°, 90°, 70°, 80°, 32°, 90°, 90° in fifteen eggs observed.

Another point that appears to offer unusual difficulties to the experimentator is connected with the movement the egg performs after the embryo begins to form, which render the reference of organs to special regions of the egg by no means easy. Thus Roux[3, 4, 5] and Schultze working upon similar material by similar methods arrive at very different conceptions of the relationships of the dorsal and ventral parts of the frog to the white and black parts of the egg.

Roux holds that the medullary folds, that is, the dorsal region of frog, appear upon the white or lower pole. This is seen when eggs are fastened in normal positions and is also inferred from experiments in which injury to the black pole remains as injury to the ventral side of the embryo. The reason other observers find the dorsal area on the upper black pole is that the egg turns over so that the dorsal field floats uppermost. The blastopore first appears just beneath the union of black and white, the equator, and then shifts over while closing to the opposite side of the equator. Where the blastopore first appears arises the anterior end of the medullary plate and extends across the white pole to the closing region of blastopore. All this is on lower side when egg is fixed, but the free normal egg turns upward so that the region of first appearance of blastopore rises and carries the head area into the uppermost pole where the black pigment was at first.

(To be continued.)

[2]A. Rauber: Furchung und Achsen-bildung. Zool. Ang. 9, 1886, p, 157–9.

[3]W. Roux: Zur ersten Entwicklung des braunen Grassfroches. O. Schultze, Biol. Centb. vii, 1888, pp. 421–424.

[4]W. Roux: Zur Frage des Axenbestimmung des Embryo im Froschei. Biol. Centb, viii, 1889, pp. 399–412.

[5]W. Roux: Ueber die Lagerung des Materiales des Medullarrohres im gefurchten Froschei. Anatomische Anzeiger iii, 1888, pp. 697–705, figs. 1–4.

RULES OF NOMENCLATURE ADOPTED BY THE INTERNATIONAL ZOOLOGICAL CONGRESS HELD IN PARIS, FRANCE, 1889.

Translated from the French by Moritz Fischer.

I. Nomenclature.

1. The nomenclature adopted for organisms is a binary and binominal one. It is Latin or latinized. Each organism is distinguished by a generic name, followed by a specific name as: *Corvus corax.*

2. In case varieties must be distinguished, the use of a third name is permitted, as: *Corvus corax kamschaticus.*

3. Since it would be wrong to write *Corvus kamschaticus* the insertion of the word *varietas* or its abbreviation *var.* between the specific and the varietal name is not essential.

4. When the word *varietas* is used, the name of the variety agrees with it as: *Corvus corax var. kamschatica.* If the word *varietas* is omitted, the varietal name agrees with the generic as: *Corvus corax kamschaticus.*

II. Generic Names.

5. Generic names should consist of one word, either simple or compound, but always written as one, whether Latin or latinized.

6. Generic names may be derived from:

(a) Greek nouns. These should have the correct Latin spelling as: *Ancylus, Amphibola, Aplysia, Pompholyx, Physa, Cylichna.*

(b) Compound Greek words. In using these the adjective must be placed before the noun as: *Stenogyra, Pleurobranchus, Tylodina, Cyclostoma, Sarcocystis, Pelodytes, Hydrophilus, Rhizobius.* It is permissible to place the adjective after the noun as: *Hippopotamus, Philydrus, Biorhiza.* Names so formed are inelegant and should not be imitated.

(c) Latin nouns as *Ancilla, Auricula, Cassis, Conus, Dolium, Metula, Oliva.* Adjectives (*Prasina*) and past participles (*Productus*) should be avoided.

(d) Compound Latin words as: *Stiliger, Dolabrifer, Semifusus.*

(e) Greek or Latin derivatives expressing diminution, comparison, resemblance, possession, as: *Lingularius, Lingulina, Lingulinopsis, Lingulella, Lingulepis, Lingulops,* all derived from *Lingula.*

(f) Mythological or heroic names as: *Osiris, Venus, Brisinga Velleda, Crimora.* Such names, if not Latin, take a Latin termination as: *Aegirus, Gondulia.*

(g) Names used by the ancients as: *Cleopatra, Belisarius, Melania.*

(h) Modern patronymics. These take an ending to indicate dedication.

Patronymics taken from Latin and Germanic tongues retain their original spelling including diacritic marks.

Names terminating with a consonant take the ending *ius, ia, ium* as: *Selysius, Lamarckia, Köllikeria, Mülleria, Stålia, Kroyeria, Ivañezia.*

Names terminating with the vowels *e, i, o, y,* take the ending *us, a, um* as: *Blainvillea, Wyvillea, Cavolinia, Fativa, Bernaya, Quoya.*

Names terminating in *a* take the ending *ia* as: *Danaia.*

Names ending in *n* or *ean* follow the preceding rule but take a euphonic *t* as: *Payraudeantia.*

(i) Names of ships which take the same terminations as the mythological names (*Vega*) or the modern patronymics as: *Blakea, Hirondella, Challengeria.*

(j) Barbaric names taken from languages spoken by uncivilized races as: *Vanikoro.*

Such names must take a Latin ending as: *Yetus.*

(k) Words formed by arbitrary combination of letters as: *Fossarus, Neda, Clauculus.*

(l) Names formed by anagrams as: *Vertusia, Linospa.*

7. With patronymics consisting of two words only one of these is used as: *Selysius, Targionia, Moquinia, Edwardsia, Duthiersia.*

8. In generic names formed from modern patronymics the particles are omitted, the articles are retained as: *Selysius, Blainvillea, Lacazea, Lacepedea, Benedenia, Chiajea.*

This rule does not apply to modern patronymics in which the particle has united with the noun as *Dumerilia.*

9. The names specified in article 6, paragraphs f, g, h, and i, should not be used to form compound words. Generic names such as *Eugrimmia, Buchiceras, Heromorpha, Mobiuspongia*, are not elegant.

10. Generic names already existing in botany should not be used in zoology and *vice versa.* A certain number of such names is now common to both kingdoms and does not cause serious inconvenience as: *Balanus, Myrrha, Hagenia, Mirbelia.*

III. Specific Names.

11. Specific names, whether nouns or adjectives should consist of one word only. It is, however, permissible to use compound modern patronymics or compound words indicating comparison as: *sanctæ-catarinæ, zan-mayeni, cornu-pastoris, cor-anguinum*, etc. In using compound names the two words must be united by a hyphen.

12. Specific names can be divided into three classes:

(a) Nouns and adjectives descriptive of a certain characteristic of a species (form, color, origin, habitat, use, habits, etc.) as *cor, cordiformis, gigas, giganteus, fluviorum, fontinalis, edulis, piscivorus, flavipunctatus, albipennis.*

(b) Names of persons to whom a species is dedicated. These names must be put in the genitive. The genitive is always formed by the addition of *i* to the full name of the person to whom one dedicates as: *cuvieri, linnei, cotteaui, muelleri, sebai, rissoi, pierrei.*

In case the name applied is a given name or a surname which has been used and declined in Latin it follows the rules of declension as: *plinii, aristotelis, victoris, antonii, elisabethæ, petri.*

(c) Names in apposition with generic names and constituting a sort of prenomen as: *leo, coret, hebe, napoleo, arctos, calcar.*

13. A Latin adjective is best adapted for a specific name, it should be short, euphonic and of easy pronunciation. It is, however, permissible to use latinized Greek words or indeclinable barbaric words as: *hipposideros, echinococcus, zigzag.*

14. The specific name must never be a repetition of the generic name as: *Trutta trutta.*

In case a varietal name is used it must never be a repetition of the specific name as: *Amblystoma jeffersonianum jeffersonianum.*

15. The prefixes *sub* and *pseudo* can be used with adjectives and nouns only, *sub* with Latin adjectives, *pseudo* with Greek nouns as: *subterraneus, subviridis, pseudacanthus, pseudophis, pseudomys.*

These prefixes cannot be used with proper nouns. Words like *sub-wilsoni, pseudo-grateloupana* are barbarous.

16. The termination *eidos* or its Latin form *oides* can be used only with Latin or Greek nouns. They cannot be used with proper nouns.

17. If the specific name requires the use of a geographical name this must be put in the genitive, or its adjective form must be used if it was known to the Romans or latinized by the writers of the middle ages. Used as an adjective it must be written with a small letter as: *antillarum, lybicus, ægyptiacus, graccus, burdigalensis, iconensis, petrocoriensis, parisiensis.*

18. All geographical names which do not come under the preceding category must be changed into adjectives following the rules of Latin derivation and retain the exact spelling of the radical if this has not been used in Latin as: *neo-batavus, islandicus, brasiliensis, canadensis.*

19. If from the radical of the geographical name two Latin adjectives have been derived as *hispanus* and *hispanicus* they both cannot be used in the same genus.

20. This rule also applies to common names as: *fluviorum, fluvialis, fluviatilis.*

21. In transforming into Latin adjectives the names derived from the various languages using the Latin alphabet such as the Neo-Latin and Germanic tongues, the original spelling is retained and likewise all diacritical marks as: *spitzbergensis, islandicus, paraguayensis, patagonius, barbadensis, färöensis.*

22. Geographical names derived from names of persons are transformed into Latin adjectives according to rules 18 and 19 as: *edwardiensis, diemenensis, magellanicus.*

The name of islands such as St. Paul, St. Thomas, St. Helena, can retain their noun form but must then take the genitive ending as: *sancti-pauli, sanctæ-helenæ.*

IV. Writing of Generic and Specific Names.

23. The generic name must be written with a capital letter.

24. The specific name takes either ac apital[1] or a small letter in conformity with the rules of spelling as: viridis, magnus, Cuvieri, Caesar.

25. The author of a species is he who:

(a) First describes and names the same according to Section I.

(b) According to the same section names a species already described but still unnamed.

(c) Substitutes for a name not agreeing with Section I a name agreeing with said section.

(d) Substitutes for a specific name used twice a new name.

The name of the author of a species follows the specific name and is written in the same characters as the text; if the text is Roman, the name of the species is in italics and vice versa as: La *Rand esculenta* Linne vit en France.

26. When the name of the author of a species or a subspecies is cited and abbreviated, the list of abbreviations proposed by the Zoological Museum of Berlin must be used.

V. Division and Consolidation of Species.

27. When a gènus is sub-divided the old name must be retained in the sub-division which contains the original type.

28. When the original type is not clearly specified the author who first sub-divides the genus can apply the old name

[1]The rule of the *American Naturalist* is *invariably* to begin the specific name with a small letter. Otherwise there can be no uniformity. According to the rules of English capitalization we would write *Cardium cor* and *Cervus Canadensis;* the Germans would write *Cardium Cor* and *Cervus canadensis.*—Ed. Am. Nat.

to whatever sub-division he may select and this application cannot be changed subsequently.

29. The division of species is subject to the two preceding rules.

30. If in consequence of the division of a genus, a species is put into one of the divisions of the primary genus, the name of the author of the species must follow the specific name. Several notations are in use which we insert below in the order of their merits, taking as an illustration the old *Hirudo muricata* Linne, 1761, placed in the new genus Pontobdella by Leach in 1815:

1. *Pontobdella muricata* Linne.
2. *P. muricata* (Linne).
3. *P. muricata* Linne (sub *Hirudo.*
4. *P. muricata* (Linne) Leach.
5. *P. muricata* Leach ex Linne.

31. A genus formed by consolidation of several old ones takes the name of the oldest of them.

32. This rule applies when several species are consolidated into one.

33. When, in consequence of consolidation of two genera, two organisms, having the same specific name, are found in the same genus, the most recent receives a new name.

VI. Family Names.

34. Family names are formed by adding the ending *idæ* to the radical of the genus serving as type. The sub-divisions of the family are named by adding the ending *inæ* to the name of the genus serving as type.

VII. Law of Priority.

35. The name originally given to each genus and species is permanent, provided:

(a) The name has been announced in a publication in which it has been distinctly and sufficiently defined.

(b) The author has properly applied the rules of binary nomenclature.—E. M. Museum, Princeton, New Jersey, Nov. 14th, 1891.

RECORD OF NORTH AMERICAN ZOOLOGY.

Continued from Vol. XXV, p. 311.

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PLATE XVI.

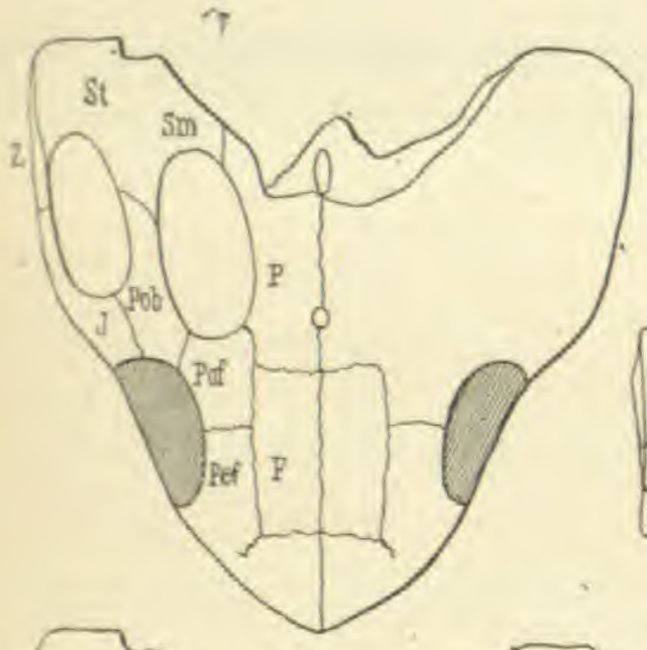
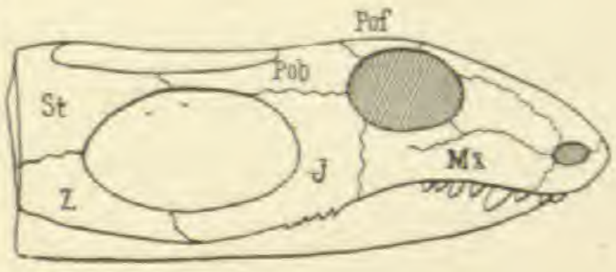


FIG.3.



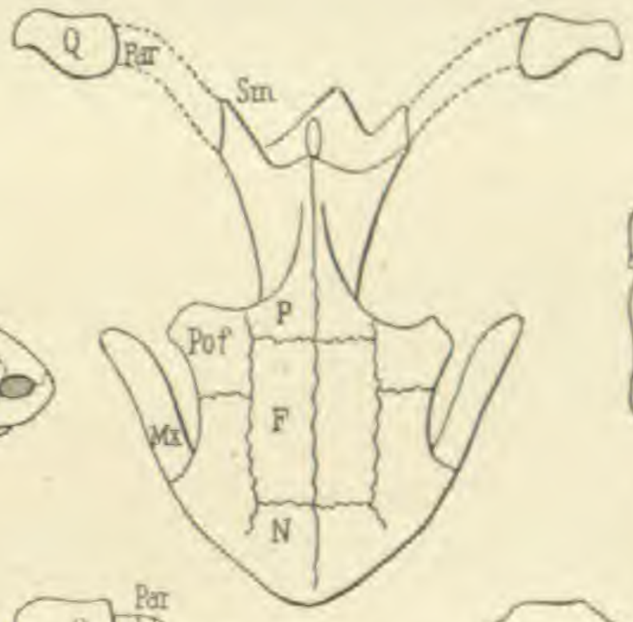
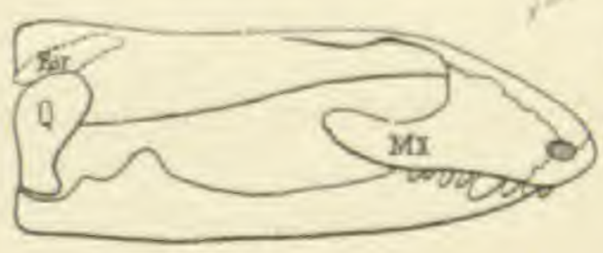


FIG.6.



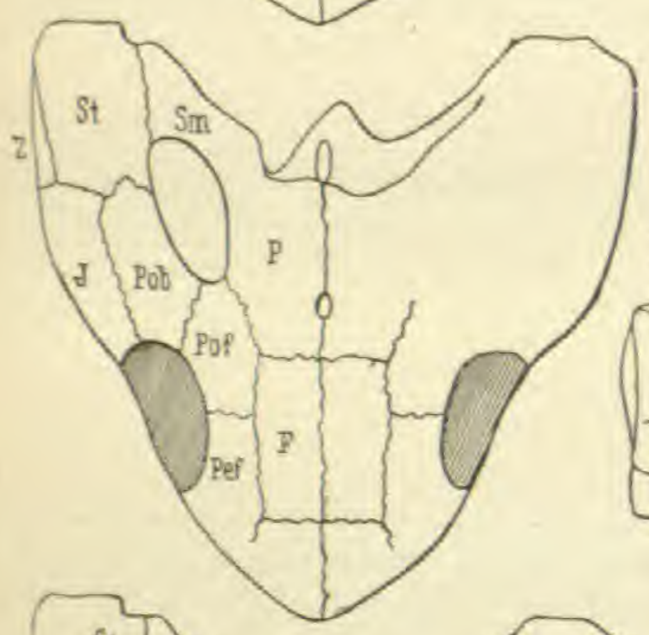
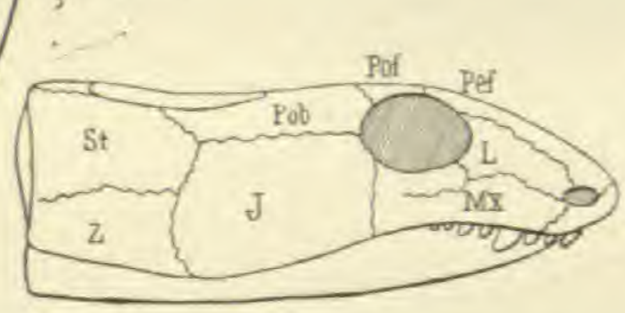


FIG.2.



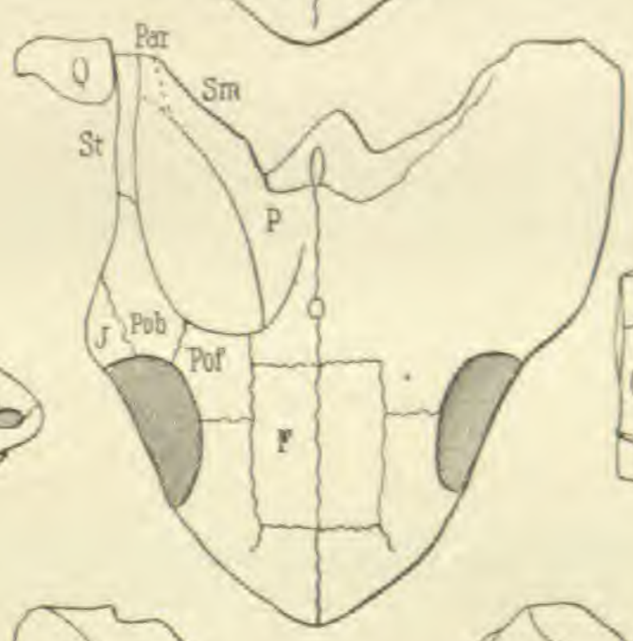
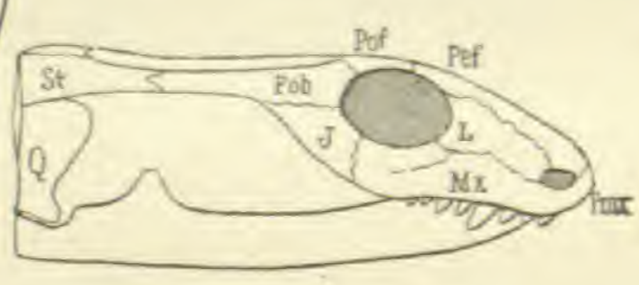


FIG 5



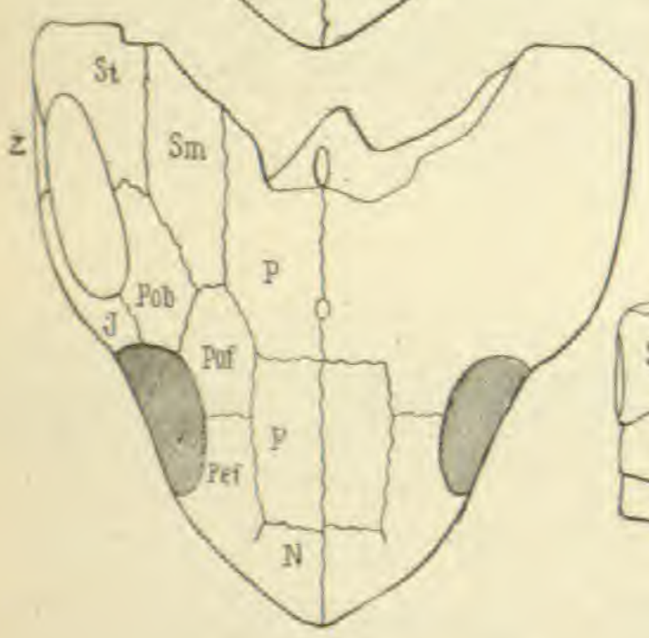
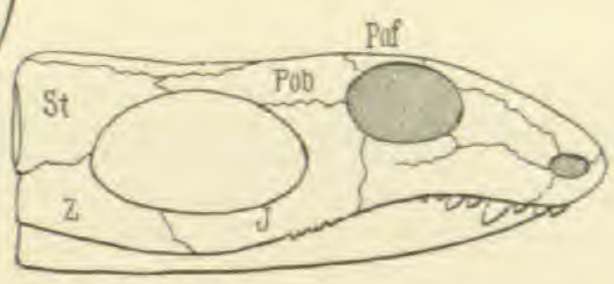


FIG.1.



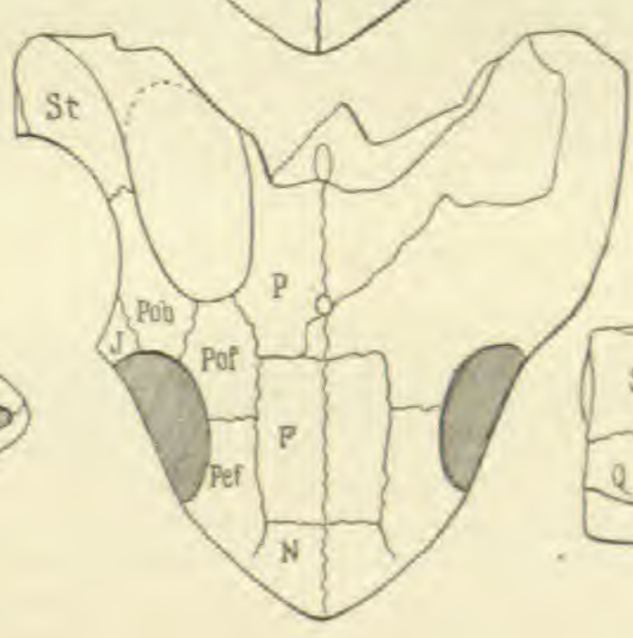
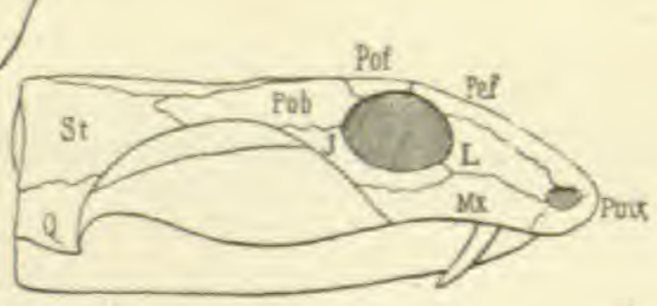


FIG 4



1. *Pelycosauria.* 2. *Pseudosuchia.* 3. *Rhynchocephalia.* 4. *Anomodontia.*
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EDITORIALS.

EDITORS, E. D. COPE AND J. S. KINGSLEY.

—Those Western State Universities which are situated in the smaller towns labor under great disadvantages. They are not in position to attract the attention of the greater body of educated men in the State, while they are peculiarly exposed to the influences of local politicians and the like. There seems to be a feeling upon the part of the townspeople that in some way the State institution is their exclusive property and that their wishes should be final in all matters relating to its management. In case any of the professors fail to fit in with the local political or religious tendencies, steps are taken by the whole community to make his position disagreeable, while not infrequently underhanded measures result in the resignation of the undesirable persons. These remarks are suggested by the recent history of the State University of Missouri. Some three or four years ago the Legislature of that State, in the course of some resolutions upon the condition and objects of the University, quite pointedly told the citizens of Columbia that the University was not their peculiar property. Apparently the hint was wasted, for the present special Legislature has called for bids from the various cities of the State looking towards a new location for the institution. All friends of education can but hope that the new situation will prove more favorable than the old, for so far in its history—whether the result of Columbian influence or not the University has produced no results at all commensurate with the outlay upon it. It is hardly necessary to say that the University of Missouri is not alone in its unfortunate situation.

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RECENT LITERATURE.

Heliotropic Animals.[1]—In connection with the work of Prof. E. B. Wilson upon the heliotropism of Hydra, (AMERICAN NATURALIST, May, 1891,) a brief review of the present paper of Dr. Loeb and some notice of other contributions to the same subject by the same author may not be without interest as pointing out the wide extension of such phenomena amongst animals and their identity with those commonly observed amongst plants.

The author's thesis is that experiments demonstrate a complete agreement between the movements that animals perform under the influence of light and those that have been demonstrated in plants.

Following Sachs the heliotropic phenomena of plants are briefly reviewed as follows:

Stems and roots which bend to or from the source of light until they take the *direction* of the light, are said to be positively or negatively heliotropic. That this bending is not simply a process of greater growth on the more shaded side is shown by the fact that negatively as well as positively heliotropic plants grow more in the dark.

That the direction of the light is the determining movement is seen in the actual locomotion of many spores to or from the light.

The more highly refrangible rays, blue and violet, are the active ones in producing heliotropic movements.

Movements within a single cell result in the arrangement of chlorophyll bodies with reference to the direction of the incident light and as all plants are to be regarded as a continuously connected set of cells, or as one protoplasmic mass, the true explanation of heliotropic movements may invoke a movement of negative protoplasm away from and of positive protoplasm towards the light.

In plants, then, light produces an orientation dependent upon its direction and upon its character, wave length, etc., and continues to act a stimulus when of constant intensity.

A brief survey of the previous work upon heliotropism in animals serves to point out the insignificance of the results achieved.

Réaumur, 1748, and Trembley, 1791, made direct observations upon the effect of light upon moths and Hydra, but no extensive examination of the subject was attempted. Later Bert, 1869, Lubbock, 1883, and Graber, 1884, made extensive researches into the action of colored

[1]Dr. J. Loeb: Der Heliotropismus der Thiere. Würzburg, 1890.

light and light of varying intensity, but arrived at results that are to be objected to as too strongly implying the conscious action rather than the mechanical reaction of the animal when effected by light. Their anthropomorphic nomenclature, use of terms implying a preference for or love of one form of light and the method of determining this preference by taking the majority vote of the animals experimented upon, stands in striking contrast to the work of Stahl, 1880, and Engelmann upon Infusoria, for here we find the movements of orientation of the animal ascribed to the directive influence of the light, not to the animal's choice.

Dr. Loeb's experiments are conducted with the greatest simplicity of apparatus and the results are at once evident, yet it is to be borne in mind that animals may not exhibit heliotropism except at certain stages of their existence and even then the reaction to light may be neutralized or modified by the co-existence of other modes of stimulation. Thus insects respond, it seems, to peculiar contact stimuli in such manner as to place their bodies with reference to adjoining surfaces; some for instance, taking up positions upon projecting corners of a box, others only in the hollow angles.

The form of reaction to contact stimuli is distinguished as "Stereotropism" and together with geotropism will be later seen to play an important role in the resulting movements of animals when exposed to light.

The fifth section of the brochure deals with the experiments upon the caterpillars of *Porthesia chrysorrhœa* and serves as an introduction and detailed illustration of the methods and results subsequently described in other cases.

The experiments are as follows:

About 100 small caterpillars that have escaped from the nest in which they pass the Winter and which have not as yet taken food, are put into a test tube in a room at 12°–15° C.

When placed horizontally upon a table covered with black paper and with the axis of the tube at right angle to the window the caterpillars all crawl toward the window on the upper side of the tube, the head and ventral side directed towards the light; reaching the end of the tube they remain pointing towards the light.

As often as the tube is turned through 180° the caterpillars repeat the movement. If then the test tube is put parallel to the window the caterpillars scatter all along it but only upon the upper side. When in the first position the animals have collected at the window end of the tube they leave that end as soon as it is covered over by an

opaque object and crawl towards the lighted end, but as soon as they emerge from the obscured region they turn about with the head towards the window and remain thus at the boundary of obscured and illuminated parts of the tube—not scattering through the latter part.

By leaving a small area uncovered along the upper side of the obscured part of the tube when it is turned to the window, the caterpillars continue on into this region as if it were not covered at all, though passing towards the window from a more generally illuminated part of the tube into one only illuminated from a narrow line. They move along the upper side with ventral aspects towards the light.

All the experiments were conducted in diffuse daylight but succeed the same, though more rapidly, in direct sunlight. One other experiment upon the relation of movement to direction of light is this: the test tube with animals at one end, *a*, is put on the table with this end away from the window but in a strong beam of sunlight coming obliquely from the window to strike the test tube nearly at right angles. Now the animals are in the strong sunlight, but, directed as it seems, by the diffuse light coming from the other end of the tube, *b*, nearer the window, they all wander toward that end, *b*. Modifying this so that the end, *b*, is in the sunlight while the end, *a*, is away from the window and in diffuse light the animals still go toward the window though now leaving the lesser illumination for the more intense one.

To determine the action of light of various refrangibility the tube is covered by colored glass. Thus if blue glass cover the entire tube the animals act as if white light were used, but under red glass they react very slowly indeed. The same results are obtained with colored solutions instead of glass.

Covering one end of the tube, (either end) with blue glass produces no visible result other than that observed when white light was present all along the tube, but if red glass be used the animals move just as if the red region were the obscured, not illuminated region, of the first experiments. When the window end is covered by red and the room end by blue, the animals collect at the boundary between the two when the tube is perpendicular to the window, but when parallel to the window they distribute themselves all along the blue region.

It is thus the more strongly refrangible rays which are effective, the less refrangible rays having little influence.

A certain intensity of light is necessary in these experiments since in the evening the light gradually ceases to produce movements and artificial light may be intense enough to act like sunlight. Moreover

of two unequal lights the more intense is followed by caterpillars. In all the experiments the stimulus continues as long as the light remains unchanged: the caterpillars remain at the end of the tube though the other end may be open.

Other stimuli that might vitiate the result ascribed to light are to be mentioned under the titles of negative geotropism, contact and temperature. The first phenomena are those seen when the animals creep up a vertical surface, but this is overcome by the action of light as shown by illuminating the tube from below through a narrow slit in an opaque covering, then the animals overcome the negative geotropic tendency and move down towards the light.

The effects of contact stimuli are seen in the tendency of the caterpillars to collect on the convex edges and corners of solids—a tendency that controls their position upon the buds of trees as well as on the objects offered them in the laboratory.

A source of warmth is unlike a source of light in that the caterpillars move away from it: this is made evident from experiments upon the animals in opaque boxes when brought near a closed stove. The movements are, however, not in the line of direction of the heat rays.

These experiments in *Porthesia* have been repeated upon nearly 100 species of insects but with the same results, so that they will serve as type of the reaction of a positively heliotropic animal.

Certain special cases of interest remain to be discussed: first the old problem of the moth and the candle.

When *Sphinx euphorbiæ* or other nocturnal moths are kept in a glass box they fly towards the window side at dusk, or in the daytime if disturbed. When an artificial light and a window are at opposite sides of the room the moth goes to one or the other according to the intensity.

Here also it is shown that it is the blue and not red light which directs the flight. It seems that these nocturnal moths have periods of sleep followed by periods of greater sensitiveness to light—being sensitive in the night. This rhythm is moreover not easily disturbed for when kept several days in a dark box the moths still continue to be restless in the evening. During the period that they are heliotropic they agree with the *Porthesia* caterpillars in all respects.

Plant lice in the winged state exhibit strong positive heliotropic movements and are also negatively geotropic and forced to move away from heat just as are the larvæ of *Porthesia*.

The young however offer unexplained phenomena, in not reacting to light but having definite positions upon the stem and under sides of the leaves of plants that do not appear due to any of the above causes.

Ants however are not heliotropic in the winged state until the period of sexual excitement, when they swarm out for the nuptial flight. Such ants gave the same results in the laboratory experiments as did the caterpillars under the same circumstances.

The two sexes differ, however, in that the males continue to go towards the light when its intensity has become too slight to affect the female. The others seem not to be heliotropic at all, from the author's observations at least.

The ninth chapter is devoted to the phenomena exhibited by flies. The larvæ of *Musca vomitoria* were experimented upon, either in test tubes or directly upon the table, and yielded the same result regarding the directive influence of light, white and colored, with the important exception that the animals move away from and along the direction of the light, being in fact *negatively* heliotropic.

That this is true of the youngest larvæ at time of hatching is demonstrated by allowing eggs to hatch out upon plates blackened with soot: the young then leave traces of their lines of progress and these are away from the light. If two windows at right angles supply light, the direction of march is in the diagonal between the two lines of stimulation. When, however, the eggs hatch in darkness, the young crawl in all directions. Certain complications, however, arise in the course of young larvæ as they seem to have a peculiar tendency to arrange themselves with the ventral side turned toward the light, provided this is strong sunlight. Heat appears to exercise no definite directive influence, though the presence of food causes them to move towards it and there is also a strong contact stimulus evinced in the tendency the larvæ exhibit to crawl under foreign bodies—passing thus under plates of transparent glass where negative heliotropism cannot be cited as the cause of the movement.

Though the larvæ are thus negatively heliotropic the adult fly is positively heliotropic as can be seen by repeating the experiment applied to the plant lice. Here however the problem is often made more complex by the numerous other stimuli which may act upon the fly and more or less nullify the results of heliotropism.

Negative heliotropism is shown also in the larvæ of two beetles, *Tenebrio molitor* and *Melolontha vulgaris*, combined in the first case with the peculiar contact sensitiveness, stereotropism, that leads the larvæ to collect in the concave angles of a dark box.

Though Dr. Loeb's experiments have been for the most part made upon insects, yet he states that he has been able to demonstrate heliotropism identical with that of plants in frogs, white mice, *Gammarus locusta*, *Cuma rathkii*, slugs, planarians, earthworms, leeches, and other worms.

Apparently the experiments of Romanes upon echinoderms are entirely unknown to him.

In this connection two other contributions to the subject of animal heliotropism, both by Dr. Loeb, may be reviewed as extending the observed facts over a wider field.

Groom and Loeb[1] found by direct experiment upon the larvæ, nauplius, of a barnacle, that these animals swim towards or away from the light, following the direction of the light and not going towards the more intense light. Moreover, here as elsewhere, it is the more refrangible rays which are most potent.

The heliotropic movements are, however, not always positive or negative but are interchangeable in any one individual, so that after the larvae have been in the dark some time they are all positively heliotropic, but when exposed to the light and moving towards it for some time they become, some sooner than others, negatively heliotropic and swim away from the light, etc.

This alternation of effect in the action of light is then applied by the authors to the explanation of some of the diurnal changes in the position of pelagic organisms, their wandering to and from the surface of the sea.

In another paper[2] Loeb shows by experiment upon the large annelid *Spirographis spallanzanii* that here also the annelid turns towards the source of light, placing its body so that the axis of its somewhat umbrella shaped expansion of radiating branchial plumes coincides with the direction of light. Now as the animal is a sedentary annelid living in a stout leathery tube from which only the branchial and anterior end protrude, this tendency to point to the light is resisted by the elasticity of the tube.

The tube however is found to bend also, after some time, so as to incline one way or another according to the direction of light, and then remain permanently bent for months, in fact when the animal is removed the tube is still bent.

[1]Groom and Loeb: Der Heliotropismus der Larven von Balanus perforatus. Biolog. Centralblatt, X, pp. 160–177, 1890.

[2]Dr. J. Loeb: Weitere Untersuchungen über den Heliotropismus der Thiere. Bonn, 1890.

As a direct bending of the tube by mechanical force does not result in this permanent change of form the author seeks to explain the observed result by the suggestion that the animal, bending to one side, reconstructs or adds to the walls of the tube on that side and so forces it to maintain its new position.

Again in a Serpula which lives in an inelastic calcareous tube, experiment shows that by changing the direction of light the tube becomes also changed in its direction. Here, however, the process is a very slow one and results from the growth of the newly formed part of the tube in the direction in which the worm turns its branchiæ and head under the influence of light; the tube once formed does not bend.

The dependence of the arrangement of animal structures upon the direction of light is shown again in the case of a certain sertularian hydroid. When pieces of the stem are inserted upsidedown in sand the old lower end, now exposed to the light, sends out both new stems and new roots. The new stems, as they grow, take the direction of the light rays and so do the new roots, but the former grow towards the light the latter directly away from it; are then positively and negatively heliotropic respectively. Adventitious roots coming out from the inverted stem show again this same negative heliotropism.

In the light of these and other experiments upon the direct response of animals to stimulation by light, gravitation, contact, etc., the author here protests against the introduction of "instinct" and "will" in the explanation of such phenomena, relegating such expressions to the same category as "vital force."

To return to the main paper.

Another extension of heliotropic phenomena is made in the case of the movement of the pigmental processes of the outer cell-layer of the retina in man under the action of light. In this part of the subject the author has no new observations to record, though his explanation of the movements of orientations of eye and head as due to the above heliotropism is sufficiently novel. The twelfth chapter concludes this contribution to heliotropism. Here we find some new facts brought together with some of those observed upon insects to show that the movements of an animal when acted upon light depend upon its morphological structure. Thus in a bilaterally symmetrical animal the oral end is found to be more irritable than the aboral end, the dorsal and the ventral sides not equally irritable, while symmetrical points right and left of the median plane are equally irritable. Hence arises the tendency to move directly towards or away from the light

with the median plane in the line of light, and the peculiar tendency to place the ventral or dorsal side towards the light in some cases.

In an appendix certain interesting experiments upon geotropism in insects are communicated in addition to those mentioned in the part treating of heliotropism. That caterpillars and beetles, (Coccinella) rapidly ascend vertical sides of boxes and remain at rest at the top is ascribed to a negative geotropism; while the various positions taken up by cockroaches, butterflies, spiders, etc., when at rest is likewise an orientation with reference to gravitation, direct or indirect.

Most suggestive experiments in extension of this view in which it appears that insects in a centrifugal machine perform some of the compensating movements ascribed to the function of the semicircular canals in vertebrates can be only mentioned in passing as they lead too far from the main thesis. That the geotropism is not confined to insects is well shown by Loeb[1] in the case of certain sea cucumbers (*Cucumaria cucumis*) which ascend to the top of an aquarium even when the apparatus is so devised that there is no question of greater air supply etc., at the top.—E. A. Andrews, Feb. 12, 1892.

The Homologies of the Cranial Arches of the Reptilia.—The following paragraphs contain an abstract of a paper read before the U. S. National Academy of Science under the above title on April 19th, and published in the Transactions of the American Philosophical Society in May, 1892.

The paper recorded an analysis of the cranial characters of the genera of Reptilia discovered in Permian beds in North America by myself. Those especially studied are Pariotichus, Pantylus and Chilonyx, which belong to the Cotylosauria (Cope; Pariasauria Seeley); and Edaphosaurus, Clepsydrops and Naosaurus, members of the Pelycosauria (perhaps equal the Theriodonta of Owen); and Diopeus g. n., founded on *Clepsydrops leptocephalus* Cope. The Cotylosauria have the temporal fossæ overroofed, so that the skull has the general character of that of the Stegocephalous Batrachia, with which it also agrees in its segmentation, an agreement especially well marked in Chilonyx.

The hypothesis of Baur was tested in its application to the origin of the bars of the Reptilian skull. This hypothesis supposes that the bars have been derived from the Cotylosaurian roofed skull by perforation, a kind of natural trephining; the position of which has determined the position and constitution of the bars or remaining portions

[1]J. Loeb: Ueber Geotropismus dei Thiere. Arch. f. d. ges. Phys. xlix., 1891.

of the roof. The existence of the genera of Cotylosauria in America and South Africa (Pariasaurus Owen), in the Permian beds, gives probability to such a theory, and I selected the genus Pantylus which presents the most unmodified type, as serving best as a basis of comparison for other orders of Reptilia. The segments concerned are the postfrontal, postorbital and jugal in front; and the supramastoid, supratemporal, and zygomatic, as the posterior elements of the roof and its resultant arches. The name zygomatic was employed for the element often called quadratojugal; supratemporal for the so-called squamosal; and supramastoid for the mastoid of Cuvier, a name already given by Cuvier to a distinct region of the mammalian skull.

I showed that the modifications of the Cotylosaurian roof, fall into the following categories.

1. "Roof reduced at margins only." (Baur).
One arch remaining (postorbital-supratemporal) in reduced types; or none; — *Testudinata.*
2. One perforation only; no marginal reduction.
Perforation superior, not interrupting postfronto-supramastoid connection; — *Ichthyopterygia.*
Perforation superior, interrupting postfronto-supramastoid connection; — *Pseudosuchia.*
Perforation inferior, not interrupting postfrontal or postorbital connections; — *Pelycosauria.*
Perforation extensive, preserving only the jugal-zygomatic connection; — *Sauropterygia.*
3. Two perforations; no marginal reduction.
Postfrontal supramastoid connection interrupted; — *Rhynchocephalia.*
Postfrontal and postorbital elements fused; — *Dinosauria.* *Crocodilia.* *Pterosauria.*

4. One foramen and inferior reduction by loss of zygomatic arch.
Quadrate bone fixed by suture; — *Anomodontia.*
Quadrate not fixed by suture; — *Squamata.*

The clearing up of the homologies of the arches is necessary to the correct understanding of the relations of the members of the Reptilia.

Five plates illustrate the memoir, of which three are here reproduced, copied from the Transactions of the American Philosophical Society.—E. D. Cope.

PLATE XVII.

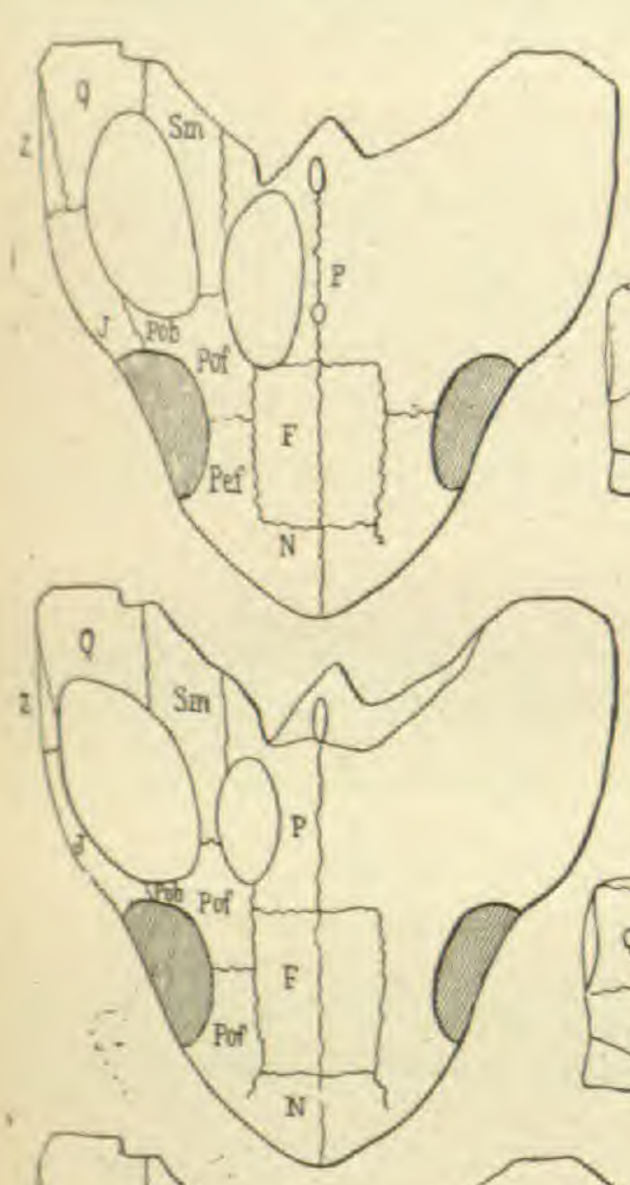


FIG. 3.

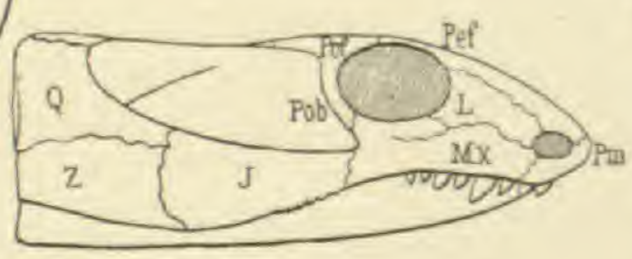
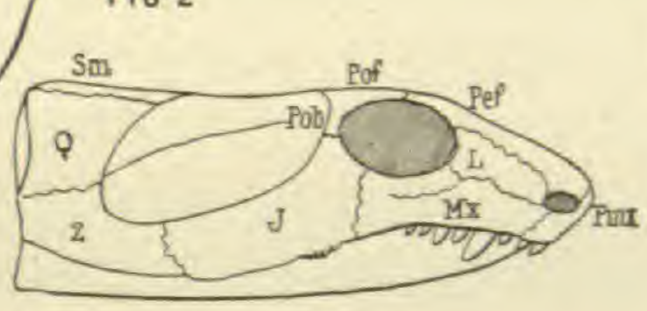


FIG 2



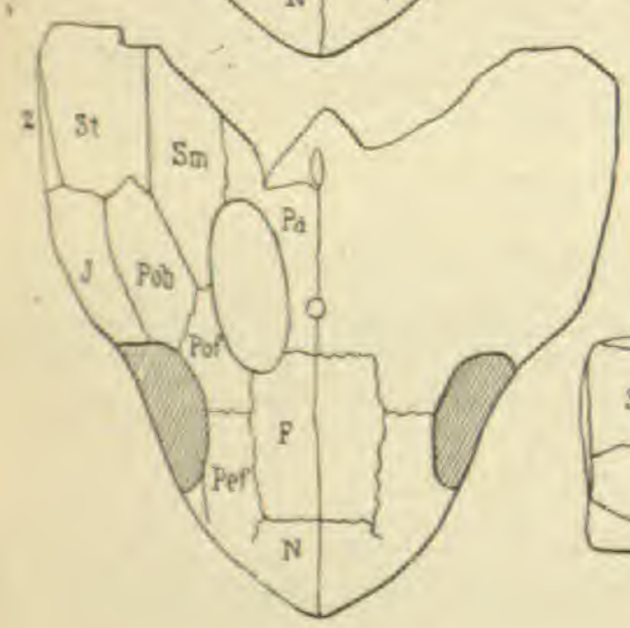
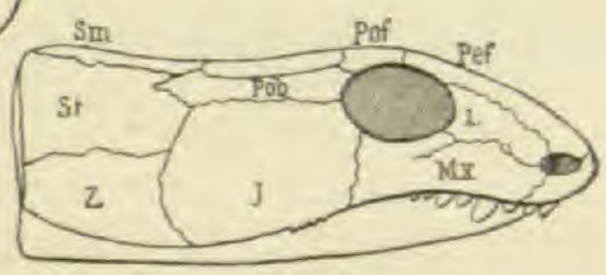


FIG 1



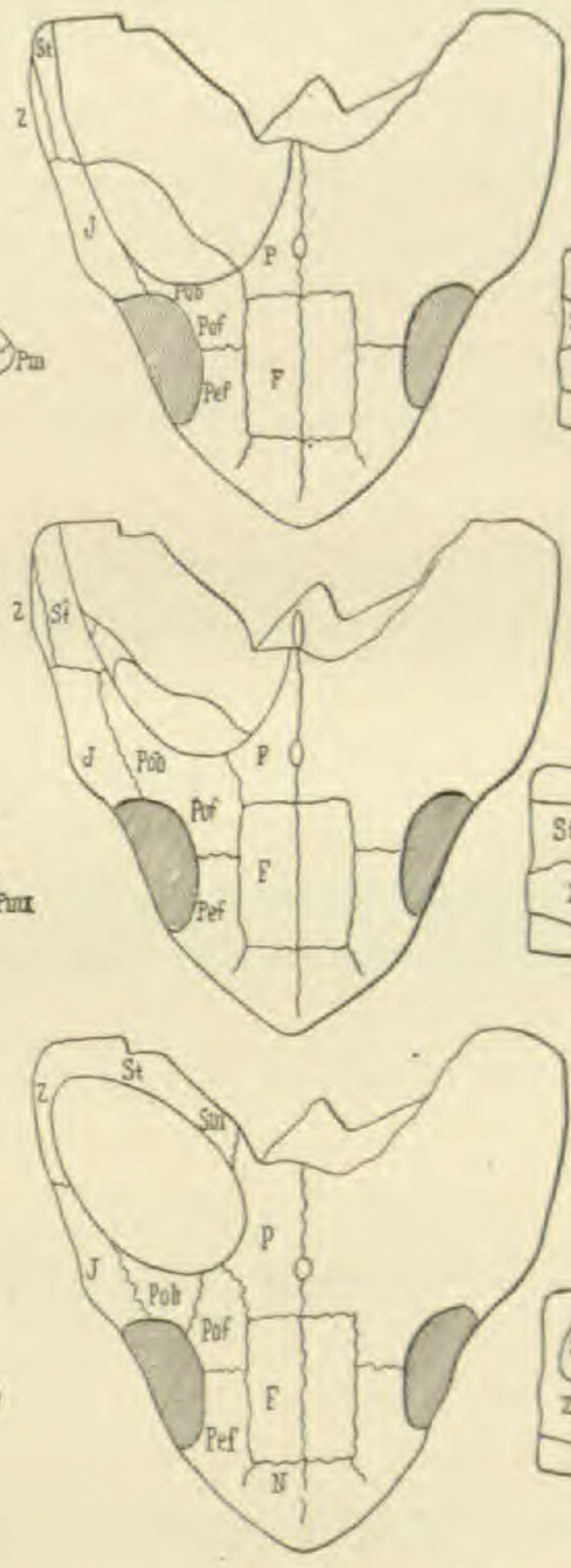


FIG. 6.

FIG 5.

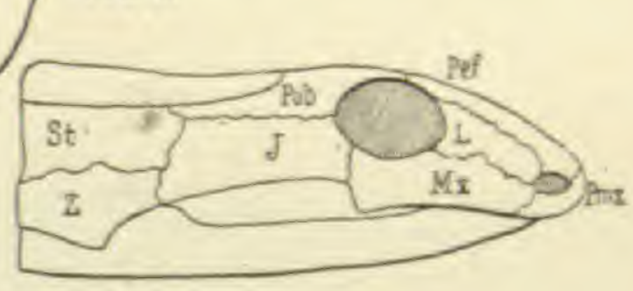
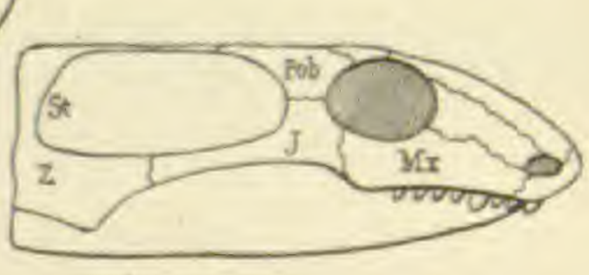


FIG. 4.



1. *Ichthyopterygia.* 2. *Dinosauria.* 3. *Crocodilia.* 4. *Sauropterygia.*
5–6. *Testudinata.*

General Notes.

GEOLOGY AND PALEONTOLOGY.

The North American Coal Supply.[1]—General Wistar's discussion of the North American Coal Supply has been published by the Phila. Academy. The author first calculates the existing quantity of available coal in North America, the present and prospective rate of its consumption, its probable duration, and some of the physical consequences of its entire combustion. The figures and conclusions of the United States Census returns of 1889 have been followed, modified somewhat by the author's personal observations.

"The entire carboniferous area of the United States, excluding the broken Rocky Mountain territory is given at 219,080 square miles. A large proportion of this area, however, never did contain coal; and there are minor areas where more than two-thirds of the original beds have been carried away along with the adjacent protecting rocks and scattered far out on the sea bottom.

Again, much of the coal possesses no economical value because of its crushed and impaired condition, its detached position in small basins, and to the thinness of many beds. These reductions may be considered to offset the following items not considered in the Census report:

1. The detached basins in the Rocky Mountain territory.
2. The inaccessible coal of the arctic and tropical regions.
3. The relatively small beds of Nova Scotia and British Columbia.

Assuming then, the area, 219,080 square miles, as the area of mineable coal, the author discusses at length the data for calculating the average thickness and arrives at the conclusion that six feet is an admissable working estimate. This gives 219,080 square miles reduced to acres multiplied by 6 feet (of thickness) and by 800, being the available tonnage per foot of thickness from each acre, would give the tonnage, which is 673,013 millions of tons.

The same Census report states the consumption during the year 1889 at 126,097,779 tons, and the increase of consumption to have been at the rate of 100 per cent. per decade. From these figures the

[1]Remarks on the Quantity, Rate of Consumption, and Probable Duration of North American Coal, and the Consequence to Air-Breathing Animals of its entire Combustion. Proceeds. Phila. Acad., 1892, p. 82.

author calculates that the entire coal supply will be consumed at the end of 112 years from the year reported on, or say by A. D. 2001.

This is a fair deduction from facts which are known, and from reasonable estimates, the author calls attention to the importance of looking for some "power" or "force" to take the place of that generated by the combustion of coal when that supply shall be exhausted, as it undoubtedly will in little more than three generations. He maintains there is no intelligent ground for the expectation of the discovery of any new force, but suggests that physicists study more effective and cheaper methods of obtaining electrical energy.

The latter part of the paper is devoted to interesting speculations as to the effect of the increased amount of carbon dioxide in the atmosphere, resulting from the combustion of so much carbon, upon animal and vegetable life.

Cretacic Marine Currents in France.—At a recent meeting of the Académie des Sciences de Paris, M. Fouqué presented a note from M. Munier-Chalmas on the distribution and the direction of the marine currents in France during the upper Cretacic period. He shows the influence of the Alps upon the limitation to the South of that mountain system of certain molluscs and echinoids peculiar to southern regions, and gives an interesting picture of the vanishing from North to South, through the narrow Paris basin, of certain fossils peculiar to the northern seas: Micrasters, Belemnites, Rhynchonellas, etc.

This fact is analogous to what is now going on in the neighborhood of the Straits of Gibraltar. (Revue Scientifique, 9 April, 1892.)

Professor Marsh on Extinct Horses and Other Mammalia.[1]—In the American Journal of Science and Arts for April and May, 1892, appear two articles by Professor Marsh on the above subjects. As they are rather more than usually curious contributions to literature, they deserve early notice. The first cited is stated in the title to be "On Recent Polydactyle Horses," but it turns out to include a discussion of the extinct ancestors of the horse. This is preceded by descriptions of some remarkable examples of horses with supernumerary digits, one of which has rudiments of four in the anterior foot, a number unprecedented in the annals of polydactylism. The author then gives figures of the feet of the extinct horses, to

[1]On Recent Polydactyle Horses, Amer. Journ. Sci. Arts, 1892 April, p. 339.—A New Order of Extinct Eocene Mammalia, Amer. Journ. Sci. Arts, May, 1892, p. 445.

which he has applied the names Orohippus, Mesohippus and Miohippus, and shows what has been already suspected, that they do not differ from those described and figured many years previously as Hyracotherium for the first named, and Anchitherium for the second and third. He laments the tendency of naturalists to adhere to the appropriate names given by Professor Owen many years ago to the suborders Perissodactyla and Artiodactyla, and their failure to adopt his own names given to the same divisions, most unnecessarily, many years later. He then repeats as original some generalizations as to the origin of the line of the Perissodactyla, including the horses, which had been long previously made by others, and repeats a new name given to the extinct order Condylarthra, which was intended by him to express an anticipation of its future discovery. Unfortunately this prophecy had been made by others in 1873, and the discovery of the order had been already made and published (1881) before this prophecy of Professor Marsh's was uttered and the speculative name given (1885). He then goes on to state that the genus which first demonstrated the character of this ancestral type as foretold by Cope (1873), which is known as Phenacodus, is the American representative of Hyracotherium, and was previously named by him Helohyus. Professor Marsh evidently greatly mistakes the characters of Phenacodus, as that genus belongs to a distinct family and order from Hyracotherium. In spite of this assumption as to the ancestry of the horses, Professor Marsh contributes further to the confusion of his writings, by proposing a new name (Hippops) for the speculative ancestral horse. On the strength of his discovery (?) as to the true position of Helohyus, he proposes for it a new family of which it is the type, with a definition which in no way differs from that already given by other authors to the Hyracotheriine division of the family Lophiodontidæ,[1] and which excludes Phenacodus and all other Condylarthra from its limits. It is interesting to observe that Professor Marsh did not define the alleged genus Helohyus when he proposed it, and it is very curious that he does not do so now. He next defines for the first time his "Orohippidæ"; but the definition does not distinguish whatever it is supposed to embrace, from the before-mentioned "Helohyidæ," and we have further confirmation of the prevalent opinion that this name is also superfluous. On the next page definitions of the alleged genera Eohippus, Helohippus, Orohippus and Epihippus, are given for the first time, *i. e.* sixteen years after the names were proposed (except Helohippus, which is new). The names

[1]American Naturalist, 1887, 993. Perissodactyla.

should therefore bear date, 1892. The author shows that Eohippus is not as primitive a type as Systemodon, and that it is little, if at all, distinct from Hyracotherium. Helohippus he does not distinguish from Pliolophus Owen (1841). "Orohippus" is not distinguished from "Epihippus." He then fails to distinguish "Miohippus" from the long known Anchitherium, and correctly describes the characters of Protohippus as though he had discovered them, although they were made known by others seventeen years ago.

The article in the May number of the American Journal recites that Professor Marsh has "discovered" a new order of Ungulata which he calls the "Mesodactyla," which is established on a new genus which he terms "Hyracops." This genus is defined with the omission of essential details as to the structures of the upper and lower molars. It is said to resemble Meniscotherium, differing only in that the last premolars resemble the true molars. This definition is of very doubtful value, since in Meniscotherium the last inferior true molar is like a true molar, and the last deciduous superior molar, has the same peculiarity, and persists, as Marsh observes, a long time.[1] Professor Marsh gives us figures of the fore and hind feet of his specimen, which are very welcome, as the structure of the former has been hitherto unknown. These figures show that the reference of Meniscotherium to the order Condylarthra made in 1885 is correct. As to the name Mesodactyla, it will probably be adopted when the universally adopted Artiodactyla and Perissodactyla are put aside for the names Professor Marsh so strangely desires us to use in their place. The proposal of a new name is all the more remarkable since Professor Marsh had already proposed a new name (as recited in the first article here commented on) for the theoretical type which is actually represented in this foot structure, as anticipated by Cope in 1873, and actually discovered in 1881.[2] In his discussion of the affinities of this form, Marsh repeats well-known generalizations as new and especially one made by myself, which has not found general acceptance, viz: that this type (the Condylarthra) is ancestral to the Lemurine Quadrumana. This generalization is fully confirmed.—E. D. Cope.

On the Correlation of Moraines with Raised Beaches of Lake Erie.—During the field seasons of 1889, 1890 and 1891, Mr. Frank Leverett made a series of observations of the raised beaches

[1]Such a specimen is represented by Cope in the Tertiary Mammalia. Pl. xxvi, fig. 2, 1885.

[2]American Naturalist, 1881, p. 1017.

of Lake Erie, which are embodied in a paper published in the American Journal of Science, April, 1892. The results of the author's studies are summarized as follows:

"It appears that Lake Erie, in its earlier stages, was but a small body of water, its size being conditional by the position of the retreating ice-sheet and by the height of the Western rim of the basin it occupied. It at first occupied only a portion of the district between the outlet and the Western end of the present lake, the remainder of the basin, including the whole of the area of the present lake, being occupied by the ice-sheet. Its South and North shores were then at the Van Wert ridge, while its Eastern border was at the Blanchard moraine.

"By a recession of the ice-sheet Northeastward to about the meridian of Cleveland, the lake became much expanded and its level was lowered a few feet, though the outlet still continued down the Wabash. Its North and South shores then occupied the Leipsic beach, while on the East the wave still beat against the ice front. The ice-sheet itself seems to have broken into bergs at its margin, and to have formed no terminal moraine at that time, though its lateral moraine is well developed.

"A subsequent recession resulted in the lowering of the lake below the level of the Ft. Wayne outlet, probably by opening a passage to the Chicago outlet, for no other outlets were open to this lake at that time through the Huron and Michigan basins. The North and South shores of the lake were then occupying the Belmore beach, while the East shore was unrecorded because the waves beat against a vanishing sheet of ice, and the ice itself, as in the preceding stage seems to have failed to form a terminal moraine, though its lateral moraine is strong.

"From the phenomena attending the replacement of the three beaches in Ohio by moraines, we are led to suspect that two later beaches which die away in Southwestern New York are there connected with moraines, and that similar moraines will be found to connect with the beaches of Lake Ontario, at points were they disappear on its Eastern and Northern borders.

"Differential uplift was slight in the Western Erie basin compared with what it was in the Eastern Erie basin and the Ontario, in Michigan, and on the Canadian shores of Lake Huron and Georgian Bay. The data at hand indicate that it amounts to scarcely more than ten feet in the whole area of the portion of the Erie basin West of Cleve-

land, and has therefore played an insignificant part in causing the three stages of the lake herein described.

"The bulk of the moraines is many times that of the beach deposits, though no longer time was involved in their deposition. The ice-sheet was therefore a much more efficient transporting agency than the lake waves.

"The extreme scarcity of evidence of life in these waters, though negative in its nature, and therefore to be taken with caution, is quite accordant with the theory deduced from the relation of the beaches to the moraines, viz: that the beaches are of glacial age."

Glacial Movements.—Prince Roland Bonaparte has been carrying on some extensive researches on the advance and recession of the glaciers of the French Alps. His work is thus referred to by the *Revue Scientifique*, April 9, 1892.

In order to express in figures the extent of glacial movements, Prince Roland Bonaparte, in 1890, had a certain number of marks put at the foot of sixteen large glaciers of Pelvoux. Whenever it was possible he had made a detailed topographical plan of the front of the glacier which, at the same time, was photographed from a point carefully marked. These operations repeated each year will furnish, and have already furnished precise data as to the oscillations of the glaciers, they will some day, perhaps, show a connection between their movements and the general phenomena of the atmosphere. For the present, the results which he has obtained from sixteen glaciers, from 1 to 6 kilometers in length, show that during 1890 and 1891 several of them have ceased to recede and have become stationary, which indicates the close of a period of general recession which began about 35 years ago. But the period of forward movement in the glaciers of Pelvoux is quite recent, for the facts observed go to show that the first glaciers which have advanced commenced to do so within the last few years.

The exact measures taken by Prince Roland Bonaparte are supplemented by the observations made at his request by the guides of that region in 1891; these extend over twenty-eight other glaciers of Pelvoux and can be summed up as follows: Eight glaciers advancing, twenty glaciers receding, and ten glaciers stationary. Finally, in 1891, the author marked fifteen glaciers in Savoy, and twenty in the Pyrenees. In these two regions the greater part of the glaciers are still receding, but they are increasing at their source, which indicates a speedy change to an advance.

Geology of the Tonga Islands.—In the May number of the *Geological Magazine*, 1891, Mr. Alfred Harker makes the following statements concerning the Tonga Islands in the South Pacific Ocean:

"It is well known that most of the Pacific islands which have been explored seem to be built largely of either volcanic or calcareous formations, usually supposed to be of recent origin. Indeed, the idea seems to have been entertained in some quarters that such was the universal construction of the islands. Drasche, writing in 1879, restricted this theory to those islands lying eastward of a certain line, drawn from Kamschatka through Japan, the Philippines, New Guinea, New Caledonia, New Zealand, Auckland, and Macquarie Islands to the Antarctic Victoria. Even at that time, however, such rocks as clay-slates, graywackes, etc., had been recorded in the Chatham Islands and New Britain, east of Drasche's line, and leptinites, granite, and gneiss in the Marquesas, far to the East. Later researches have proved the existence of numerous crystalline rocks, igneous and metamorphic, in the larger islands of the Fiji and Solomon Archipelagos, and suggested that in many other islands such rocks may be only masked by a comparatively thin covering of organic or volcanic accumulations.

"It may be inquired, then, whether the Tonga Islands show any indication of the existence of denuded crystalline rocks beneath the newer deposits. No such rocks have been found in place, and the evidence available is very slight. Ena, the most Southerly of the larger islands, differs to some extent from the rest in geological structure, and from the Eastern shore of this island Mr. Lister collected a boulder, one of many seen there, which is neither a volcanic nor an organic rock. I have described it (*Geol. Mag.*, April, p. 172) as a uralitized gabbro, and, though some petrologists would prefer to name it diabase, it is unlike any superficially erupted lava. Further, there is no doubt that it is derived from the island on which it was found. The only other suggestive point is the rare presence of minute fragments of red garnet and blue tourmeline in the calcareous andesitic sandstones largely developed on the same island. These fragments, blown out from a volcano, point to the existence of metamorphic rocks below, though at what depth it would be idle to speculate.

"With the exception of Falcon Island rocks, all those examined from the Tonga Island appear to be of submarine formation. The absence or presence in different strata of any sensible proportion of calcareous matter and organic remains is perhaps related to the more or less rapid rate of accumulation at different epochs of eruption. The volcanic material ejected seems to have been almost exclusively of frag-

mental character, and in some cases there are indications of violent explosive action. This is quite in accord with the andesitic nature of materials thrown out, which are of types common in the Pacific region. As to the age of the rocks, it would be idle to speak until the evidence of their organic contents has been duly set forth; but it would undoubtedly be very rash to refer them all to a recent age, and some of them may be found to go back far into the Tertiary times."

Geological News—General.—Several fossils collected by M. Griesbach while exploring the Central Himalayas closely resemble those found in the corresponding Alpine beds. In view of this fact, the Academy of Sciences of Vienna has decided, by an agreement with the Indian Government upon an exploration of the Central Himalayan region in order to compare its geology with that of the Eastern Alps. M. Diener, president of the Alpine Club of Vienna, will take charge of the expedition. (*Revue Scientifique*, April, 1892.)

MINERALOGY AND PETROGRAPHY.[1]

Petrographical News.—One of the most valuable contributions to American petrography that has yet appeared is that volume of the Arkansas Geological Survey Report that treats of the eruptive rocks of the State. In it the late Dr. J. F. Williams[2] gives an excellent account of the little-known but very interesting eleolite and leucite rocks that occur as bosses and dykes in Pulaski, Saline, Hotsprings, Garland and Montgomery Counties. It would be well worth the while to give a full abstract of the author's careful investigation of these extremely rare rock-types, but space allows merely a reference to the mere outline of his work. Especial importance is attached to the study of the eleolite syenites at the present time, particularly where its plutonic and dyke forms occur together, since Rosenbusch has recently prophesied the existence of a group of dyke forms which he calls monchiquites, that will be found to occupy a position among the eleolite rocks corresponding to that held by the camptonites, among the plagioclase rocks. The age of the Arkansas eruptives is probably late Cretaceous. In Pulaski County they form the main mass of Fourche Mountain. The most abundant variety here is that locally known as 'blue granite.' It is a granitic porphyritic rock in which the

[1]Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2]Ann. Rep. Geol. Surv. of Ark. for 1890, vol. ii, 457 pp.

phenocrysts are orthoclase, and the ground mass is a granular aggregate of cryptoperthite, arfvedsonite, diopside, biotite, eleolite and other accessory components. Arfvedsonite is the most prominent dark constituent, while eleolite among the lighter-colored components is scarcely more than an accessory. The rock thus resembles the augite-syenite, called laurvikite by Brögger[1], but it contains so much more hornblende that Williams decided to give it a new name, pulaskite. Analyses of the rock and its feldspar follow:

	SiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	MnO	K_2O	Na_2O	H_2O	P_2O_5
Rock.	60.03	20.76	4.01	.75	2.62	.80	tr.	5.48	5.96	.59	.07
Felds.	66.95	17.87	.90		.52	.24		7.82	5.20	.30	

A second rock, occurring along the base of the mountain and a short way up its sides in the form of sheets, is known as 'gray granite.' Its structure is trachytic granular, with large twinned microline-perthites, eleolite, biotite, diopside and aegirine in large quantities. The eleolite frequently changes into analcite. The rock, though quite acid, as the analysis shows, is nevertheless an eleolite syenite, closely similar to laurdalite.[2]

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O	Na_2O	H_2O
59.70	18.85	4.85	1.34	.68	5.97	6.29	1.88

In and around the mountain are small dykes, filled with 'brown granite,' miarolitic eleolite-syenite and quartz syenite. The brown granite is an eleolite-syenite containing orthoclase, diopside, eleolite and biotite, but no amphibole. In chemical composition it is quite like nordmarkite,[3] but mineralogically it is very different. The miarolitic rocks are panidiomorphically granular. In the eleolite-syenite there is a tendency of the eleolite toward idiomorphic forms when it is not in large quantity. In the quartz syenites the quartz tends toward idiomorphism. An analysis of one of these rocks gave:

SiO_2	Al_2O_3	Fe_2O_3	MnO	CaO	MgO	K_2O	Na_2O	H_2O
64.63	18.15	3.05	1.00	1.54	.50	4.79	5.80	1.08

Rocks, called by the author border rocks, presumably occurring on the peripheries of dykes and bosses of the eleolite-syenite, contain tabular

[1]Zeits. f. Kryst., xvi, p. 28.
[2]Ib. p. 33.
[3]Ib., xvi, p. 54.

phenocrysts of sanidine and also sodalite and eleolite in a fine-grained groundmass of eleolite, orthoclase and minute idiomorphic pyroxenes and amphiboles that sometimes shows a fluidal structure. Because of their porphyritic structure and their close relationship with the eleolite-syenite they are classed by the writer among the tinguaites.

The augitic rocks associated with the eleolite-syenites in this region are classed in Rosenbusch's new division of dyke rocks monchiquite. They are all dark in color, and all are characterized by the possession of phenocrysts of augite or of biotite. Those containing olivine are placed with monchiquite, while of the non-olivinitic varieties two new groups are formed; one, called fourchite, possesses phenocrysts of augite; in the other, ouachitite, biotite occurs in large quantity. In the former augite constitutes nearly 75% of the entire rock. Its ground mass is now crystalline, but its structure is thought to be the result of the devitrification of a glassy base. In the amphibole ouachitites the phenocrysts are biotite, hornblende and a few augites in a fine-grained but originally a glassy groundmass. Augite is still the most prominent bisilicate, but it now constitutes scarcely 20% of the rock mass. The groundmass is composed of minute hornblende and augite crystals, with much magnetite and small, highly refractive grains of what the author supposed to be sphene. The base contains many small, lath-shaped crystals of feldspar. In addition to these two members of the monchiquite group, there is probably a true monchiquite at the south end of Allis Mt., in the same district. This rock is remarkable for its great number of sphene grains and for the common occurrence in it of pseudomorphs of biotite after augite.

At a few places where the contact of the syenite with the surrounding shales may be studied, the latter are found to be much changed and to have developed in them small, irregularly bounded feldspars, a few flakes of biotite, grains of magnetite and plates of hematite.

The sequence of the eruptives is believed to be as follows: Eleolite-syenite and pulaskite (same magma), fourchite, pegmatite and miarolitic dykes.

In the Saline County region the rocks are not very different from those of Fourche Mt. The prevailing gray syenite is coarser in grain than that of Fourche Mt., and its orthoclase crystals (intergrown with albite) tend to become porphyritic. The eleolite is also sometimes in large crystals. A plagioclastic variety of the same rock is slightly more granitic than the orthoclase variety. The pyroxene is aegirite instead of diopside. Pulaskite is absent from this region, but in its place occurs a porphyritic syenite with large orthoclase crystals, crys-

tals of arfvedsonite, biotite and an occasional diopside, imbedded in a fine-grained mosaic of orthoclase and amphibole. This rock also contains spheroidal masses of orthoclase crystals that may be pseudomorphs after leucite. The dyke rocks cutting the eleolite-syenite are grouped into eleolite-syenite pegmatites, aegirite tinguaites and eleolite porphyries. The tinguites are non-eleolitic, while the eleolite porphyries contain large rounded eleolites and aegirites enclosed in a fluidal mass of needles of the last-named mineral. The augitic dykes are much more common in this region than elsewhere. They belong to the monchiquites and the amphibole varieties of this rock. The ground mass of the latter consists of a transparent mass, partly isotropic and partly doubly refracting, in consequence of the development in it of plagioclase and orthoclase laths. Contact rocks are rare, but in one idiomorphic crystals of astrophyllite and aegirine were observed.

The Magnet Cove region is especially interesting, not only because of the fine minerals that occur there, but also because of the great variety of rare rocks found in the neighborhood in great quantity. It is to these latter that the minerals owe their origin. Of the eleolite-syenite occurring here three types are distinguished. One is an eleolite mica syenite, a coarse-grained rock in which eleolite has almost completely replaced orthoclase as the alkaline component. Eleolites, apatites, schorlomites and protovermiculites measuring as much as eight inches in diameter are frequently found imbedded in the decomposed rock. The principal constituents of the fresh rock are allotriomorphic eleolite, biotite crystals, idiomorphic zonal melanites, allotriomorphic schorlomites and large round masses of the same mineral, diopside, crystals of sphene, of ilmenite and of magnetite (the latter giving rise to the lodestone from which the Cove takes its name), pyrite and apatite in large crystals and in needles radiately grouped. Besides these there are also found in the decomposed rock ozarkite, protovermiculite, cancrinite and calcite. The second variety of the syenite is an eleolite garnet syenite made up of a granular mixture of eleolite, melanite and diopside, with small quantities of biotite and the usual accessories. The third type is a miarolitic variety too much weathered to yield good sections. Of the eleolitic dyke rocks one is hypidiomorphically granular, with a tendency to the trachytic structure. It contains a large quantity of orthoclase, eleolite in idiomorphic and allotriomorphic grains, large idiomorphic crystals of aegirine, cancrinite that appears to be in part primary, several other accessories and a number of secondary substances, among which may be mentioned aegirine, fluorite and calcite. A pegmatitic dyke consists of huge microline crystals,

beautiful crystals of aegirine, eleolite, eudialite, and other decomposition products of eleolite. This rock is the gangue of many of the sphene, natrolite, brucite, manganopectolite and eucolite crystals obtained in this region. Other dykes in which eleolite occurs in two generations, sometimes with and sometimes without orthoclase in the ground mass, and an eleolite tinguite, in which the phenocrysts are orthoclase are also described. But perhaps the most interesting of the rocks of Magnet Cove are the leucite dyke rocks. Of these the author distinguisues between leucite-syenite and leucite-tinguaite. The former is a hypidiomorphic granular aggregate of a pseudomorph after leucite, eleolite, orthoclase and the basic silicates, diopside and biotite. It is generally connected with eleolite-syenite, and is easily recognized by the large crystals of pseudo-leucite scattered through it. These are imbedded in a ground mass in which may be detected eleolite, black garnets and feldspar. No trace of leucite may be discovered in the large crystals. They are now composed of tabular orthoclases, interspersed with small eleolites and pyroxenes. Within the mass the orthoclase is radial, while on its periphery small tabular crystals have their symmetry planes perpendicular to its surfaces. The ground mass has the structure of an eleolite porphyry. The tinguite occurring as dykes possesses two generations of orthoclase, aegirine, eleolite and the pseudomorphs of leucite, besides many accessory components. It differs from the eleolite-tinguite mainly in the possession of orthoclase in large quantity. Analyses of eleolite-tinguite, leucite-syenite, tinguite and of the pseudo-leucites follow:

	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	SrO	MnO	MgO	K_2O	Na_2O	Cl	P_2O_5	Loss
Ele-Tin.....	53.76		23.21	1.27	3.18	2.94	.04		.23	7.01	6.97	.02	tr.	1.71[1]
Leu-Sye.....1	50.96	.52	19.67	7.76		4.38		tr.	.36	6.77	7.67			1.38
Leu-Tin.....[2]	52.91		19.49	4.78	2.05	2.47	.09	.44	.29	7.88	7.13	.53	tr.	1.19
Pseudo-Leu..	55.06		25.26			.60	tr.		.28	10.34	7.60			1.78

On the contact of the eruptives with the country rock hornstones are formed, but these are so indefinite in their character that but little could be learned from their microscopic study. In the sandstones and limestones through which the eleolite-syenite cuts there are, however, important contact minerals, many of which are of world-wide interest. Among those found in quartz rock and sandstone may be mentioned smoky and milky quartz, arkansite, rutile and hematite. The lime-

[1]The leucite-syenite contains .54% of NaCl in addition to the sodium given above, besides a trace of SO_3, and the leucite-tinguaite[2] .52% of SO_3 and .48% of insoluble oxides.

stone gave rise to perofskite, magnetite, apatite, phlogopite, vesuvianite and monticellite.

In the potash Sulphur Springs region the eleolite and augite rocks are but little different from those of Magnet Cove. The shale in contact with one of the eleolite-syenite dykes, however, differs somewhat from the contact rocks of other regions. Close to the eruptive the shale has a glassy appearance, and is cut by sheets and masses of pink and white minerals and bands of coarse crystalline calcite. Under the microscope sections are seen to consist of plagioclase, wollastonite, apatite and pyroxene in small interlocking crystals. The white masses cutting it are wollastonite, while the pink ones are xonotlite (hydrated wollastonite), in which a tenth of the CaO has been replaced by Na_2O. The author calls the variety natroxontolite.

Outside of the regions above mentioned aegirite-tinguite dykes occur at Hot Springs and at Hominy Hill, in Sec. 27, T. 1 N. R. 14 W.

The basic dykes outside of the syenite areas have been studied by Kemp, whose report comprises the twelfth chapter of the book under review. Most of them are narrow. In composition they are so closely related to the rocks already mentioned in this abstract that they are regarded as genetically connected with them. The most interesting of the dyke masses are the ouachitites. These are dark in color, and are all porphyritic, with very large phenocrysts of biotite and augite. The groundmass in which these are imbedded is composed of augite, magnetite and glass. An analysis of one of these rocks yielded:

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	K_2O	Na_2O	H_2O	CO_2	P_2O_5	Tot.
36.40	.42	12.94	8.27	4.59	14.46	11.44	3.01	.97	2.36	3.94	1.04	=99.84

This rock, which is so very basic, is a constant associate of the more acid eleolite-syenite. All the basic dykes that have thus far been discovered in the State are mentioned in a table containing 280 entries.

In conclusion the author recapitulates his classification as follows: The eleolite plutonic rocks are called eleolite-syenites. From these are sharply separated the dyke forms, mentioned under eleolite-syenite dyke rocks, which are not porphyritic, but in the variety pulaskite (hornblende eleolite-syenite) are trachytic; the eleolite porphyries, in which eleolite phenocrysts occur; and the tinguites, characterized by porphyritic crystals of orthoclase. Among the latter are the eleolite, leucite and aegirite varieties.

Miscellaneous.—NEW BOOKS, ETC.—Mr. Lane[1] has recently published two tables for the use of students in optical mineralogy and petrography. One is devoted to the rock forming minerals. These are divided into three classes, the opaque, the isotropic and the anisotropic groups, and the members of the latter class are subdivided in accordance with the strength of their double refraction, their habit and the character of their extinction. There is no doubt but that with a little practice the student may easily learn to distinguish between the various minerals found in rocks if he will only follow the scheme carefully after reading the explanation accompanying it. In the second table the author gives an excellent resumé of Rosenbusch's classification of massive rocks, as elaborated in his 'Massige Gesteine.'——An even more recent tabulation of igneous rocks is that of Dr. Adams[2], since it reflects Rosenbusch's present attitude with respect to rock classification. In it the author represents in a very concise and simple form the differences between the various types of massive rocks, and suggests at a glance their relationships. In each of three horizontal columns are placed the plutonic, dyke and volcanic rocks in such a way that the corresponding members of all classes fall in vertical columns. The novel features of the classification are the following: Leucite-syenite is made a sub-group under the eleolite-syenites, and the tinguaites are represented as their corresponding granitic dyke forms. The rocks in which leucite, nepheline and melilite replace feldspar are given columns between the orthoclase and plagioclase rocks, as better indicating their chemical affinities than is the case when they are placed beyond the plagioclastic rocks. Each of the three groups is divided in accordance with the presence or absence of olivine, and in the niche for the plutonic nepheline combination is placed the new type iolite, recently described by Ramsay[3]. The lamprophyric dyke melilite rock is alnoite. Among the lamprophyric plagioclase nepheline rocks are fourchite and monchiquite, the latter with and the former without olivine. Malchite is a new rock described by Osann. It is the granitic dyke form of diorite. The diabases are put in the paleovolcanic class, which, by the way, is not sharply defined from the neovolcanic class. The basic non-feldspathic rocks are separated into the pyroxenites and the peridotites, which names sufficiently define themselves. Dr. Adams deserves the thanks of all petrographers for

[1]Am. Geol., June, 1891, p. 341.

[2]Can. Rec. of Sci., Dec., 1891, p. 463.

[3]Cf. AMERICAN NATURALIST, 1892, p. 334. By mistake iolite occurs in the wrong column in the table.

his enterprise in the preparation of this, the only modern classification of massive rocks published.——INSTRUMENTS.—Salomon[1] describes a simple piece of apparatus by means of which the density of a heavy liquid may be rapidly determined without the inconvenience of the use of a Mohr's balance. It consists essentially of a W-shaped graduated tube, whose manipulation depends upon the principle that the heights of the liquid columns in its two arms will vary with their differences in density. By the aid of the instrument the specific gravity of each mineral in a rock powder may be determined without once emptying it of its solution.——Four new microscopes for crystallographic and petrographical purposes have lately been introduced to the favor of investigators. The three[2] from the manufactory of Zeiss in Jena present no peculiar features. The fourth was made by Nachet to the order of Wyrouboff[3], especially for observations at high temperatures. The objective is below the object, and the nicol prism and the illuminating mirror are above it. The stage is fixed, while the microscope body revolves. Attempts to use converged light with this instrument have failed, because of the great heat to which the condensers are subjected.

[1]Neues. Jahrb. f. Min., etc., 1891, ii, p. 214.
[2]Czapski, Neues. Jahrb. f. Min., etc., B B. vii, p. 497.
[3]Bull. Soc. Franc., d. Min. xiv., 1891, p. 198.

BOTANY.

New Studies in Fecundation.—M. Leon Guignard publishes a paper in the[1] *Annales des Sciences Naturelles*, entitled "New Studies of Fecundation, with a comparison of the morphological phenomena observed in plants and in animals."

He reminds us that until very recently the essence of fecundation was supposed to reside exclusively in the union of two nuclei of different sexual origin, and that the protoplasm played but an accessory part in the process; that in phenogamous plants, for instance, the male nucleus penetrates alone the oosphere to the exclusion of its accompanying protoplasm. His recent observations, however, and the discovery of certain new bodies, new at least in vegetable cells, which he calls "directive spheres" and which play their part in the process throw quite a new light upon the subject and moreover bring into close accord the phenomena as existing in the two kingdoms. He follows the development of the reproductive elements, male and female, from the very beginning to their adult stage so as to determine the mode of differentiation by which they acquire sexual characters and then further follows these sexual elements, showing which are the essentially active parts, and how the union between them takes place to form the first embryonic cell.

The account which he gives of the technique employed in his researches is far from satisfactory; indeed he says himself that the "technique applicable to the study of vegetable protoplasm leaves much to be desired." As fixative agents he used absolute alcohol, corrosive sublimate, picric acid and osmic acid; to stain the protoplasm and the spheres he hardened the specimen in absolute alcohol and then in 10 per cent. solution of zinc sulphate or ammonia alum, followed by hæmatoxylin. Fuchsine and methyl green proved also of special value in distinguishing the plasmic contents of the cells.

He first describes the formation of the reproductive cells, the pollen grains and the embryo sac, using as his subject a species of lily, *Lilium martagon*. He traces each step in clear language and by the aid of beautiful figures, from the undifferentiated meristem of the budding anther to the archesporia or pollen mother-cells, to the special mother-cells and the mature pollen grains; and with the same nicety, the origin of the embryo sac with the egg apparatus (oosphere

[1]Ann. Sci. Nat.; Bot. Tome XIV. pp. 163–288. Plates 9 to 18.

and synergidæ), the antipodal cells and the secondary nucleus. In all this there is nothing essentially different to what may be found in the better text-books. But at a certain point in the development of the pollen, he shows us cells in stages of karyokinesis having each just twenty-four chromatic rods, each rod with its parallel halves stuck together throughout their length but destined to separate and form parts of the two new nuclei. In subsequent figures are shown the well formed anthers, the completed pollen sac and the special mother-cells. Upon the completion of the tapetal layer the primary mother-cells cease to divide and become the special mother-cells which now increase in size, become filled with protoplasm, each with a large nucleus and several nucleoli and closely appressed to the nuclear membrane, the two directive spheres lying side by side. Within the nucleus is a band of chromatin which may be likened to a tangle of endless narrow ribbons. In the last division by which these cells were formed the nuclei still showed the twenty-four rods of chromatin. There now follows a resting stage preparatory to forming the pollen grains. As the nucleus is to enter into activity its chromatic frame-work (charpente) may at least in part be traced out along its very sinuous course but without discovering any free ends within the nuclear cavity or any evidence of its being aught than a continuous endless filament; which means that the twenty-four rods must have fused end to end in its formation. A little later are to be seen twelve segments, each formed of two series of chromatin granules, free in the nuclear fluid. The halves of these rods are exactly the same in length and are united by a common hyaloplasm and from their ends also are still projecting fine delicate threads of the same plasma. The directive spheres now take their place as poles, the rods are carried to the equator and the spindle is soon completed. The halves of the rods now separate, that is, the ends directed towards the center or axis of the spindle, part first and the segments on their way back to the poles assume the forms of the letters U or V. The two nuclei thus formed at once enter again into division and the four pollen grains are perfected.

With each nuclear division the "directive spheres" have doubled, so that each new nucleus is provided with two spheres.

For the formation of the generative or sexual nucleus proper, the pollen nucleus divides to form a vegetative and generative nucleus.[1] Within the pollen tube the generative nucleus undergoes a second division, the spheres likewise doubling, and, as the plane of division is

[1]By the artificial culture of pollen the generative nucleus sometimes quite escapes from the pollen tube and offers a most favorable view of the directive spheres.

transverse to the length of the tube, the two new nuclei are so placed that the lower one is preceded, and the upper one followed, by its two spheres. Both of these nuclei are accompanied by their protoplasm and each has been seen to have its twelve chromatin rods. If the vegetative nucleus has not already disappeared, it may be distinguished from the sexual elements by the difference in reaction to methyl green and fuchsine.

The steps by which the differentiation of the female factor arises may be rapidly sketched as follows: A large cell in the axial row of the nucellus is the mother-cell of the embryo-sac. In all the cell divisions of the nucellus up to the moment when one of the cells becomes conspicuously larger and ceases to undergo further division the nuclei have all shown twenty-four chromatin rods. The embryo-sac grows rapidly so as to come to occupy a large part of the nucellus, sometimes descending towards the center of the same. Its nucleus contains one or more large nucleoli in the meshes of the tangled ribbon made up of two series of chromatin granules. The two directive spheres lie in contact with the nuclear membrane and the cytoplasm is now seen radiating without regard to the position of these spheres. The ribbon now breaks into rods and the substance of the nucleoli so changes as no longer to be distinguishable from that of the chromatin segments, the number of which is now twelve not twenty-four. The spheres become active, go to the poles and are surrounded by cytoplasmic rays. At first the rods are scattered in a disorderly manner through the forming spindle, but are soon carried and properly oriented by the achromatic threads about the equator so that there may now be seen a rod to each large thread, there being however some more delicate intermediate threads to which no rods are attached. Thus is formed the spindle and disk. The rods are easily seen to consist of longitudinal halves and in the further change they split at the ends directed towards the spindle axis, one-half appearing to glide up a thread towards one pole, the other half moving down towards the opposite pole until they finally part and become new groups of twelve contorted segments, shaping themselves into two new nuclei. The centrosomes in the meantime have doubled, forming two spheres at each end of the old nuclear axis. The new nuclei so formed appear in all respects quite similar and they move to opposite ends of the embryo-sac. The lower one especially gains in size, and both continue to divide. But in the next division the lower one is seen to have not twelve, but sixteen or twenty rods, whilst the upper one and its derivatives still have but twelve. There are now four cells or nuclei above

and four below ; two synergidæ, the oosphere and a polar cell above, three antipodal cells and a polar cell below. As the oosphere has but twelve rods, the two sexual cells have thus the same number of these elements. The upper polar nucleus becomes larger than its brother nucleus of the oosphere. The lower polar nucleus moves round a large vacuole and joins the upper one of the same name, while the antipodal cells disappear. The spheres of the synergidæ are situated right and left, because in the division by which they were formed the spindle axis was horizontal ; whilst the spheres of the oosphere and upper polar nucleus are in couplets above and below these nuclei because the spindle was vertical. This position of the spheres is of importance in the act of copulation, for the first step in this process is the meeting of the two spheres from each copulating nucleus and as the male nucleus is moving down the pollen tube with its two spheres head on, so the oosphere must so present its spheres as to squarely meet them ; and to the same end the spheres of the approaching polar nuclei are most conveniently situated.

The approach of the sexual nuclei is as follow: The vegetative nucleus has disappeared while going along the pollen tube. The tube becomes narrow and insinuates its end between the epidermic cells of the nucellus. Arrived at the summit of the sac it enlarges into a flask-shaped extremity and pushes the membrane of the sac before it as it continues to advance inward either in a straight course or obliquely, without however spreading out its end upon the sac as is the case in *Monotropa* and in *Orchis latifolia*. From this time the membrane of the sac and of the tube are not to be distinguished. The tube enters by the side of the synergidæ or directly into one of them, in which latter case the contents of the synergidæ assume the peculiar appearance of disorganization. Strasburger thought that this was the rule and that the office of the synergidæ was to transmit the contents of the pollen tube to the oosphere. Whatever be the method of penetration, the male nucleus which arrives first in contact with the embryo-sac passes through the membrane and rapidly joins the nucleus of the oosphere. Strasburger now thinks that the liquid which directs this amorous flight of the male to the female nucleus is furnished by the synergidæ, playing the part which is attributed to malic acid and malates in directing the course of the antherozoids in the cryptogams. Guignard believes that this attraction may reside simply in the protoplasm of the female cell.

The male nucleus, as has been shown, is preceded by its two spheres which lie side by side and which are thus brought face to face with the

spheres of the female nucleus which they quickly join and so form two new couplets of spheres, each couplet containing a sphere of two different elements. This conjunction of the spheres takes place before the nuclei unite, but they do not fuse until the division of the nucleus begins. While still as couplets they take their position above and below, marking out the axis of the coming spindle, which is that of the long axis of the oospore. The second male nucleus sometimes escapes from and sometimes remains in the pollen tube and ultimately disappears in the protoplasm. The reason for the existence of two male nuclei is in doubt. That the division of the single primary one into the two smaller masses is so that the male and female nuclei may be nearly in equilibrum as to size, is not a satisfactory suggestion; and since the two male nuclei are equally active and effective in fertilization, the division of the primitive nucleus could not have been a matter of differentiation. After a long contact of the male and female nuclei, the nuclear membranes at the surface of contact disappear and the contents form a common mass; that is, the nuclear fluids mingle, but there is not a true fusion of the chromatic elements. Contraction and orientation of these elements follow with the formation of a spindle and nuclear disk, and a return to twenty-four rods. Twelve of these may have been furnished by each nucleus but they are not to be distinguished from one another. The two groups of secondary segments collect at the poles, a wall of cellulose is formed at the equator and two embryonic cells come into existence. Thus fecundation has resulted in doubling the number of rods in the first segmenting nucleus.

It happens with curious constancy that the secondary nucleus of the embryo-sac begins its division for the formation of endosperm, just at the time that the male nucleus penetrates the oosphere. This secondary nucleus formed by the union of the two polar nuclei, which were larger and rich in chromatin, contains a greater number of rods, as do its derivatives, than are to be found in the egg nucleus. So likewise do all the nuclei of the endosperm contain a greater number of rods than do the nuclei of the rest of the ovule and other organs of the plant. This variation in the number of rods opposes the idea of the chromatic segments retaining their individuality during the resting stage of the nucleus. In *Leuconium* and in *Galanthus*, as the embryo-sac becomes somewhat crowded with nuclei and their spheres, and as cell walls arise, there may be included as many as ten or twelve nuclei in a single cell. Under these conditions the spheres act upon closely neighboring nuclei in such a manner as to form multipolar spindles. Such figures have lately been seen by Henneguy in the parablast of

the trout, a tissue comparable to the endosperm, and also in epithelial tumors. From such multipolar figures more than one daughter nucleus may naturally be expected to be formed.

Most of these observations have been taken from the lily. Other plants show differences of more or less moment; thus, it is found that the number of chromatin rods, so constant in the sexual cells for the species, may yet vary in members of the same family.

Guignard's work was awarded the Bordin prize by the Academy of Sciences of Paris. The title of the subject given for contest required an exposition of the relations which exist between the phenomena attending fecundation in the vegetable kingdom, with those observed in the animal kingdom. This obliged him to summarize the work done by zoologists in this field, and there follow at this point some twenty pages devoted to the consideration of the sexual cells in animals, the polar globules (richtungskörper), their homologies with the spermatozoids and their general morphological value. In all this he rests upon the contributions of Lowen, the Hertwigs, Fol, Van Beneden, Boveri, Weismann, Ischikawa, Blochman, Bütschli, Whitman and others. The judges, as we learn from another source, say that this part of the work was done with skill and conscientious care. From Guignard himself we get the impression of the strict analogy of the processes of fecundation as they occur in the two kingdoms. Under the heading "General Exposition of Results" the author retraces the subject matter already given: the fixity or constancy of the chromatic rods as to number in the sexual cells; the appearance of and the mode of reduction in the number of these rods at a given stage; the constitution of the nuclei, including a discussion of the individuality of the chromosomes; the existence of "directive spheres" in all vegetable cells; the role or function of these spheres which are distinctive organs of the cells and, lastly, a review of the prevailing theories concerning the phenomena of fecundation. Of this he says, "We see that fecundation is not only a conjugation of nuclei, but accompanying this act is that of the fusion of two protoplasmic bodies whose essential elements are represented in the directive spheres of the male and female cells."

While hovering so closely about the subject of heredity it was not to be expected that it should go untouched. After noticing the theories of several prominent workers in this direction he gives in a single paragraph the gist of his own views by saying, "That all the cells, or at least, a greater part of the cells of the body possess in a latent condition all the hereditary properties of the species. A little bit of the

body can reproduce the entire organism. A branch of willow placed in water develops roots at the expense of cells, which thus come to play a part quite different to what was laid out for them in the original plant, a proof, that is, that they already possessed this property from their conception. On the other hand, a severed root may give rise to buds which bear male and female organs; so that sexual cells may be derived directly from the cellular substance of a root. The epidermic cells of a Begonia may produce an entirely new plant just as with cœlenterates, worms and tunicates, new individuals may come from buds or separate parts of the body of these animals. These facts are trite enough," he adds, "but it is well to recall them to show the solid basis of Hertwig's conclusion that, 'the nucleus, by reason of the phenomena it presents during fecundation, is the support or conservator of hereditary properties and that it reappears in the same form and with the same properties in every cell; that it is a substance removed from the grosser metamorphoses of matter by its inclusion in a special vesicle; that by a complex mode of division the daughter nuclei receive portions of the same substance, no differentiation having arisen. Just as Nägeli claims that his hypothetical idioplasm is spread throughout the body like a fine net-work, so according to my theory, every cell of the body encloses in its nucleus the aggregation of hereditary properties derived from the egg, whilst the specific properties of the cell are bound up with the development of the protoplasmic products, consequently every cell possesses the faculty, under appropriate conditions of reproducing the entire organism.'"—B. W. Barton, M. D., Johns Hopkins University, Baltimore, Md.

ZOOLOGY.

The Limpet's Strength.—The experiments made by J. Lawrence-Hamilton show that the shell-less limpet pulls 1984 times in the air its own weight, and about double when immersed in water.

Fasting fleas on an average pull 1493 times their own dead weight.

Other experimenters give the pulling power of the shell-deprived *Venus verrucosa* of the Mediterranean, a cockle-like creature, at 2071 times the weight of its own body.

The force required to open an oyster appears to be 1319.5 times the weight of the shell-less oyster. (Nature, March 24, 1892).

Dr. Steindachner has published the 15th part of his Ichthyologische Beiträge[1] in which he describes the following species of South American fresh-water fishes.

Piabuca argentinia Lin.; Iquitos.

Piabuca spilurus Günther; Hyavary.

Bergia n. g. near *Chalcinus*; no canines behind median teeth in lower jaw; lateral line median.

Bergia altipinnis sp. nov.; Arroyo Mignelete near Motevideo.

Tetragonopterus lineatus sp. nov. Iquitos.

Tetragonopterus anomalus sp. nov. Rio Parana near Corrientes.

Xiphorhamphus jenynsii Günther; Arroyo Miquelete and Parahyba.

Xiphorhamphus hepsetus Cuv.; Arroyo Miquelete and Parahyba.

Medical and Other Opinions upon the Poisonous Nature of the Bite of the Heloderma.—In North America there are two species of Heloderms,—the *Heloderma horridum* of Wiegmann, a form that does not occur within the limits of the United States, and the *Heloderma suspectum* of Cope, which is found principally in suitable localities throughout Arizona. There this, the biggest by all odds of all our lizards, is popularly known as the "Gila monster," from the fact that it was once common on the Gila River. Collectors are now rendering it scarce over nearly all its range, and no doubt the time is not far distant, comparatively, when this highly interesting species will meet with utter extinction.

Living specimens of this reptile have been in the writer's possession for a year or two together, affording him admirable opportunities to

[1]Sb. Ak. Wiss. Wien, 1891.

study it in all particulars,—advantages I have fully availed myself of, as my published papers on the subject will attest.

Adult Heloderms average some twenty inches in length, and are covered with tuberculated scales, which vary in form in different parts of the body, and in old specimens are prone to ossify over the back and top of the head. These scales are of a shiny black and orange, the two colors being arranged in a definite pattern, which latter never agrees in any two specimens. Nothwithstanding this great size for a lizard, and this most striking coloration, there are many people in Arizona and in the southwest generally that apply the name "Gila monster" to any large lizard-looking form that may come under their observation. I have had medical officers in the army, ranchmen, guides, and others, who surely ought to know better, point me out Amblystomæ, and even the common forms of the Phrynosoma, as Gila monsters. This being the case, I feel quite sure that the excellent figures which I have offered of a large female Heloderm that I had, some time ago, alive for nearly two years, will be acceptable, and in some respects exceedingly useful,—useful because the general opinion in the southwest and elsewhere is that the bite of this saurian is poisonous, and as a matter of diagnosis it is very desirable to know that the patient has actually been bitten by a Heloderm and not by something else.

Fig. 2 is from an instantaneous picture where I strapped my camera in such a position as to bring the focal axis of the lens perpendicular to the floor, where I placed a sheet of white blotting paper, over which the reptile walked beneath the instrument, allowing me to secure the photograph. In Figs. 1 and 3 the Heloderm was hypnotized, and thus easily taken. In Fig. 1 the ventral aspect of her head and body is resting upon a plane surface, which gives a flattened appearance, but otherwise the likeness is admirable. The leading herpetologist in this country, Professor Cope, who was my guest this week, examined these photographs and remarked that they gave a better idea of the form of a Heloderm than any of the many figures that had thus far been published, either here or in Europe.

We now come to consider that part of the subject that falls more properly within the title of this contribution,—in other words, the nature of the bite of these reptiles.

Even at the present writing the wide variance of opinion in these premises is truly remarkable, for some of our most distinguished investigators still disagree in the matter, and those, too, who have made the most exhaustive examinations of the saliva of this reptile.

As long ago as 1857, John Edward Gray, of the British Museum, in referring to Necturus, said: "I know of no other instance of a batrachian having this structure of its teeth, nor do I know of any instance, except in the Mexican lizard called *Heloderma horridum*, in which *all the teeth* are uniformly furnished with a basal cavity and foramen, and this lizard is said to be noxious; but the fact has not been distinctly proved."

Professor E. D. Cope, who first clearly characterized this reptile, and gave it its present name of *Heloderma suspectum*, has stated that "though the lizards of this genus could not be proved to inflict a poisonous bite, yet the salivary glands of the lower jaw were emptied by an efferent duct which issued at the base of each tooth, and in such a way that the saliva would be conveyed into the wound by the deep groove of the crown."

Then several years passed before much else was published upon this special topic of the life-history of the Heloderma, when Sumichrast, a well-known naturalist resident in Mexico, stated it as his opinion that it was the exception that small mammals died from the bite of this saurian.

Soon after there appeared an editorial in the AMERICAN NATURALIST (1882, page 842) referring to the experiments of Dr. Irwin, of the army, which went to prove that the bite of the Heloderm was comparatively harmless; but it added, further, that a specimen in the Zoological Garden of London had bitten a frog and a guinea-pig, both of which had died in a few moments. Still, the editor of the NATURALIST was of the opinion that "this might happen if this large lizard was not poisonous, and there is room for more careful experiments as to its venomous qualities."

In the same year no less distinguished an authority than Dr. Günther, of the British Museum, comes forward and states that there can be no doubt as to the poisonous nature of the bite of *Heloderma horridum*, and cites numerous cases to support his views; and Dr. Sclater, the secretary of the Zoological Society of London, apparently entertained a similar opinion, as did also the eminent herpetologist, Mr. Boulenger, of the British Museum.

During the same year the present writer, who was at that time connected with the Department of Reptiles at the United States National Museum, was severely bitten by an infuriated adult specimen of *Heloderma suspectum*, and although much pain and grave symptoms at once supervened, the results passed entirely away in a few days with barely any treatment. I published a short account of it at the time. Again,

before the year closed, Sir Joseph Fayrer brought forth some evidence, deduced from experiments, that went to show the poisonous nature of the bite of a Heloderm.

Early in 1883, however, the matter seemed to be definitely settled for good, and all through the results obtained by the very celebrated experiments of those two distinguished physicians of Philadelphia, Dr. S. Weir Mitchell and Dr. Edward T. Reichert. After a most carefully conducted series of experiments with the saliva taken from living Heloderms, these authorities were prepared to say that it possessed properties of an extremely venomous nature, killing pigeons and small mammals a few moments after they had received an injection of it hypodermically.

Five years now elapsed with hardly a printed word appearing anywhere upon the question of the poisonous or non-poisonous qualities of the saliva of one of these *suspected* reptiles. Then there appeared an account of the somewhat remarkable series of experiments made with the saliva of living Heloderms by Dr. H. C. Yarrow at the United States Natural Museum, Dr. Yarrow at the time being honorary curator of the Department of Reptiles in that institution. This investigator's methods of procedure were rather different from those adopted by Mitchell and Reichert, but apparently they were conducted with equal care, and, strange to say, led to an entirely different result. Some eight or nine experiments upon chickens and rabbits went to prove that hypodermic injections of the saliva and bites of angry Heloderms were by no means fatal to those animals, and practically they always recovered from the effects of the same. After presenting the steps of his final trial, this author concludes his account with the following remarks: "This experiment would seem to show that a large amount of the Heloderm saliva can be inserted into the tissues without producing any harm, and it is still a mystery to the writer how Dr. Mitchell and Dr. Reichert obtained entirely different results. Were it not for the well-known accuracy and carefulness of Dr. Mitchell, it might be supposed possibly that the hypodermic syringe used in his experiments contained a certain amount of Crotalus obrorca venom, but under the circumstances, such a hypothesis is entirely untenable." The following year Dr. Mitchell still adhered to his original opinion, and undoubtedly does at the present time.

Mr. Samuel Garman, of the Museum of Comparative Zoology of Harvard University, next made some very interesting experiments, by allowing large and vigorous Heloderms to bite the shaved legs of

kittens, and here again these feline victims refused to succumb to the effects of the wounds.

Very evidently the last word upon this subject has not yet been said, and opinions are very much divided,—a host of supporters appearing upon either side. I have endeavored to give in this paper the bulk of the most reliable evidence now out and up to date; but there will undoubtedly be series of interesting experiments made with the saliva of this saurian in the future, and it is very important that there should be. To such experimenters I have a few suggestions to offer here,—the same which should be borne in mind at the time of their investigations, or even in the examination of a person bitten by a Heloderm.

In the case of the latter, ascertain if possible the exact condition of the patient at the time of the infliction of the wound, as regards both sobriety and his general condition. Make sure that the reptile that inflicted the bite was a specimen of a Heloderm. Be careful not to destroy the victim with the remedies you administer to offset the effects of the bite. A quart of raw whiskey, practically given at one dose, may prove more fatal than the bite of ten Heloderms. If the patient die after the bite of one of these reptiles, be sure to ascertain whether it was from the effects of the bite or from the effects of the remedies administered. The locality of the bite and other matters, of course, should also be carefully noted. (R. W. SHUFELDT in *New York Medical Journal*, May 3d, 1891.

The Cervical Vertebræ of the Monotremata.—In the January number of this journal, 1892, I have stated that the zygapophyses are absent in the cervicals of the Monotremata. I have been looking over a paper lately by C. Hasse and W. Schwarck, Studien zum vergleichenden Anatomie der Wirbelsäule, published in Vol. I, of Dr. C. Hasse's Anatomische Studien, Leipzig 1873; I find that these authors have also described the absence of the zygapophyses in *Ornithorhynchus* and *Tachyglossus* (*Echidna*).—G. BAUR.

The Introduction of Reindeer into Alaska.—A very interesting experiment in the introduction of reindeer into this country has been commenced. Dr. Sheldon Jackson, the government agent of education in Alaska, has begun the work. During the past season he imported sixteen reindeer from Siberia, which cost about $160.00. Next year he proposes to establish a herd of reindeer in the neighborhood of Fort Clarence and expects to begin with 100 animals. Siberia has vast numbers of these animals, and in its climate and

vegetation resembles greatly Alaska, so that there is no reason to doubt that they will thrive on the eastern side of Bering Strait. The reindeer is useful as a draught animal for sleds, as well as for its milk, its meat, its skin. From the economical point of view the experiment is of the highest degree of interest, and it is gratifying to see that the Federal Government recognizes the importance of the work.

Capt. M. A. Healey, of the revenue cutter Bear, has reported to the Treasury Department, emphasizing the proposition as the most important question now before the Territory of Alaska. The recent destruction of seals and sea lions has certainly had its effect upon the food supply question of the country and islands in the neighborhood of Bering Strait, and any distress brought about by the destruction of seals may be alleviated by the introduction of the reindeer. In Iceland, where the reindeer was first introduced in 1870, it has increased greatly in number but is said to have relapsed into wildness and is now of little use to the inhabitants. It is to be hoped that better fortune will attend their introduction in Alaska, and that they will be treated as domestic animals, and not share the fate of the buffalo. (*Scientific American*, Oct. 31, 1891).

Nomenclature of Mammalian Molar Cusps.—In October 1888 I sent to the NATURALIST a table of nomenclature for the cusps of the molar teeth of Mammalia based upon the rise of these cusps from the single cone of the reptilian tooth as observed by Prof. Cope and myself. These terms have since been adopted by Cope, Scott, Lydekker, Flower, Schlosser and in part by Rütimeyer. They have not, so far as I know, been adopted by any of the palæontologists of France. Fleischmann, of Erlangen, has opposed their adoption upon the ground that Cope and myself have mistaken the homologies of these cusps in the upper and lower teeth; I have been carefully over this paper and find that every point raised by Fleischmann is erroneous. This author and Döderlein have adopted Greek symbols for the cusps.

Subsequently I have proposed to extend the nomenclature to the crests of the upper and lower molars in the Ungulata.[1] In this paper, as Lydekker has very courteously pointed out, I unfortunately confused "crochet" and "anticrochet" of Busk, and did not rightly interpret Huxley's "pillars." The latest contribution to terminology is Prof. Scott's, which is based upon the law that where the premolars

[1]Bull. Mus. Comp. Zool., Vol. XX, No. 3, Nov. 1890, p. 88.

assume the molar form the corresponding cusps *are not homologous*; this law had already been observed by Schlosser and myself (in *Hyracotherium*), and has now been worked out in many groups by Scott who will shortly publish an abstract of his results.

The principles upon which the new terminology is based are very simple:

1. The termination *-cone* is given to the central primary cusps, and *-conule* to the "intermediate" cusps.

2. The termination *-style* is proposed for the peripheral cusps arising from the cingulum—the Greek form of Huxley's term pillar; these pillars are given the same prefix as the nearest cone.

3. The termination *-loph* is given to the crests.

4. The prefixes are based upon the succession and position of the elements in the primitive evolution of the crown—viz: *proto-*, *para-*, *meta-*, *hypo-*, *ento-*, *ecto-*, *meso-*.

5. In describing the molars of the more primitive types we have to use repeatedly the term "primitive triangle" composed of the paracone, metacone and protocone—for this I propose to substitute the term *trigon* to distinguish the higher and more primitive part of the crown from the lower and secondary *talon*.

6. Corresponding or homologous elements in the upper and lower jaws are given similar terms but distinguished by the arbitrary addition of *-id*.

New Terms Proposed.

Upper Molars.	*Lower Molars.*	
Trigon	Trigonid	= Primitive Triangle { Proto-Para and Metacones.
Talon.....	Talonid	= Heel..... { Hypoconid, Entoconid, Hypoconulid.
Parastyle = Antero-External buttress.....		
Mesostyle Median External buttress,.....		
Metastyle = Postero External buttress.....	Metastylid	= (Reduplication of Metaconid in *Equidae* and other forms).
Hypostyle = Postero median buttress (developed only in *Equidae*).....		
Ectoloph = External crest...		
Protoloph = Anterior crest..		
Metaloph = Posterior crest..	Metalophid	= Anterior crest.....
	Hypolophid	= Posterior crest.....
	Hypoconulid	= Posterior intermediate cusp (3d lobe of last lower molar).

Henry F. Osborn,
American Museum of Natural History,
Central Park, New York.

April 25th, 1892.

EMBRYOLOGY.[1]

Morphology of the Vertebrate Urino-genital System.—From a detailed study of the excretory and reproductive organs of *Ichthyophis glutinosus*, one of the Cæcilians, Professor Semon, of Jena, is led to a conception of the vertebrate urino-genital system containing many points of interest and importance.

The material used consisted of embryos, larvæ and adults obtained in Ceylon by P. and F. Sarasin, and is fully described in the first sixty pages of text with the aid of fourteen plates.

Passing on to the comparative discussion of the results obtained, illustrated by diagrams, we may first give the chief facts observed by the author and then some of his applications of these to the morphology of the excretory and reproductive organs in the entire vertebrate groups.

The pronephros consists of at least twelve pairs of tubes, one pair in each segment, opening into two pronephric ducts that run to the cloaca and opening at the other end by funnels into the body cavity. The dorsal part of the body cavity receiving these twelve pairs of funnels is constricted off as a tube on each side, remaining, however, still in communication with the large ventral part of the coelom by slender tubes that become secondary funnels. These tubes next appear as branches of the original pronephric tubules, each of which now has two funnels, a ventral and a dorsal one. The dorsal tube of coelom is then partly divided by ingrowths of vascular loops, glomeruli, into chambers, one for each dorsal funnel. These chambers are the Malpighian bodies of the pronephros. Irregularities appear in the branching and connections of the pronephric tubules both anteriorly and posteriorly in this long series; finally secondary changes occur and the organ loses its function. Before this takes place the mesonephros appears and both function at the same time. Though chiefly posterior to the pronephros the mesonephros also extends forward so that both organs occur in the same segment. Then it is seen that the mesonephros is dorsal to the pronephros. At the very first the mesonophric tubules are strictly segmental, but very soon the secondary, tertiary, etc., tubules destroy the metameric arrangement. Each tubule has a funnel opening into the large coelom and also opens by what may be regarded as a second funnel into the Malpighian capsule. These meso-

[1]This department is edited by Dr. E. A. Andrews, Johns Hopkins University.

nephric Malpighian capsules may be regarded as parts of the coelom pinched off segmentally, much as those of the pronephros were. The coelom has thus given rise to two series of dorsal diverticulæ, Malpighian capsules, which remain connected with the ventral coelom by tubes with funnels, while their openings into the other nephric tubules are regarded as another primary set of funnels.

The pronephric duct serves also for the mesonephros and the two organs are also connected in another way: each segmental Malpighian capsule of the mesonephros is connected with a longitudinal cord of epithelial cells by means of a similar but more simple transverse cord. This longitudinal cord, on each side of the body, runs back to the cloacal region and is continuous anteriorly with the series of pronephric Malpighian capsules; in fact as the latter degenerate they become incorporated with the anterior end of this cord. The cord is thus a sort of degenerated remnant of a longitudinal coelom tube connected with the pronephric tubules and by solid cords with the mesonephric Malpighian capsules. This degenerate structure is that part of the adrenal body distinguished as the interrenal body of each side.

The Müllerian duct arises dorsal to the nephros and without any connection with the pronephric duct.

The free ventral part of the germinal fold becomes the fat body, some of the dorsal part the germinal epithelium. This germinal epithelium is ventral to the nephros and connected by a loose meshwork of epithelial cords with those similar cords connecting the primary mesonephric Malpighian capsules with the interrenal body. This network disappears in the female but remains, in part, in the male as the tubules conveying the sperm to the kidney. The reproductive gland is not segmentally divided nor are the anastomosing cords going to the kidney.

In applying these facts to the understanding of the urino-genital organs of vertebrates past and present the author regards *Ichthyophis* as presenting many ancestral traits.

Thus the primitive urino-genital system of the Craniata consisted of pronephros and germinal ridges extending from the region of the heart to the cloaca. The germinal cells discharged into the unsegmented dorsal part of the coelom were taken up by the segmental funnels of the pronephros. Later this dorsal coelomic space became pinched off, except for the connecting external funnels of the pronephros, and by ingrowth of glomeruli was converted into a series of Malpighian capsules. Still the reproductive cells pass into these capsules by tubes that elongate as the capsules become more deeply retro-peritoneal.

Finally, in the stage to which all Craniata attain at the present day, a second generation of tubules, the mesonephric tubules, is cut off from the primary pronephric tubules, while the Malpighian capsules divide into dorsal and ventral parts. Into the first open the new mesonephric, into the ventral the primary pronephric tubules, each by its internal funnel, while its external funnel opens into the general coelom. The appearance of this dorsal mesonephros is accompanied by a reduction and transformation of the pronephros, combined with sympathetic ganglia (suprarenal bodies) to form the adrenal body. The reproductive cells must now pass out by the new mesonephric tubules to the pronephric duct.

In male vertebrates there is in addition a reduction of the germinal epithelium to a short portion of its primitive length and a corresponding restriction of the connection of testis and nephros. This leads to the distinction between "sexual" nephros and the more posterior "pelvic" nephros, which is finally quite separated in the higher forms as the *metanephros* or true kidney.

The complete separation of testis and excretory organs in the teleosts and cyclostomes is to be regarded as secondary.

In the female, secondary changes, perhaps connected with increase in size of the ova, have led to the restriction of the egg-conducting function of the pronephros to a single tubule, which then opened into a secondary duct, the Müllerian duct, divided off from the pronephric duct. For the understanding of the true value of the peritoneal opening of the Müllerian duct and for any satisfactory homologizing of the oviducts of teleosts we must await further researches upon these organs in the ganoids.

True abdominal pores, serving for exit of the reproductive products in Cyclostomes but not in any Gnathostomes, are to be regarded as having probably taken that function secondarily. Their morphological value remains unknown: functionally they may perhaps be brought into relation with the need of communication of the coelom and external water to equalize pressure in deep sea forms.

In many vertebrates the original function of the external nephric funnels, those opening into the large coelom as contrasted with the internal funnels opening into the Malpighian capsules, that is the passing out of water from the coelom, has been assumed more and more by the glomeruli and thus the external funnels have been abandoned as useless. Along with this loss of the coelom funnels there has been a loss of cilia in the tubules, in many forms, since

there was no longer need of other than the vascular pressure in the closed system of tubules and Malpighian capsules.

The venous system has undergone important changes in connection with the nephric organs. Thus the primitive net-work of veins passing from the pronephros to the heart becomes reduced to the two posterior cardinal veins as the pronephros degenerated, though remaining as segmentally arranged veins in the mesonephric region. Later the two fused posterior cardinal veins form with the remnants of the primitive sub-intestinal veins the median post cava.

In attempting a comparison of the vertebrate and any non-vertebrate we must consider Amphioxus as in many ways a primitive form. Thus in its urino-genital system the possession of nephric tubules throughout the branchial region is to be interpreted as a retention of the pronephros in a more anterior region than that it is now retained in amongst the Craniata; while the discharge of reproductive products has been changed from its primitive course through these tubules. If Boveri succeeds, as the author seems to think he will, in homologizing the peribranchial space of Amphioxus with the pronephric ducts, which are regarded as having an ectodermal connection, the unity of the nephric system in the Chordata would be demonstrated. At the same time the resemblance to the Annelid organs becomes very striking, yet as there can be no question of derivation of Chordata from real Annelids the author asks if this resemblance may not be a case of convergence.

On the same line that E. Meyer has imagined the Annelid's metamerization to have come from the segmentation of the reproductive coelom, wonders if in the Chordata reproductive tubes may not have given rise to the mesoblastic somites, parts of which are still separated off as the Malpighian capsules with the old nephric tubules leading to the exterior, though now brought into use as parts of the excretory rather than reproductive passages.

Hermaphroditism the author thinks was not a primitive trait of the Chordata, but where occurring, as in other groups, is to be regarded as a remnant or re-occurrence of the original hermaphrodite nature of the reproductive gland in all Metazoa; such organs as the Müllerian duct in the male being transferred from the other sex; the inverse of what has taken place in the case of the mammary glands.

In connection with this work it is of interest to note that Hans Rabl[1] in a study of the adrenal bodies of birds derives the non-nervous

[1]Arch. f. mik. Anat. 38, 1891, p. 28. 3 pls.

part from the degenerating pronephric tubules, thus confirming Semon's view without a knowledge of Semon's full paper.

Formation of the Germ Layers in an Ophiurid.[1]—*Amphiura squamata* (Say) had been incompletely studied in 1870 by Metschnikoff who argued from analogy that there was here an invaginate gastrula though he did actually observe it. In 1882 Apostolides claimed that it was formed by delamination, but he gave no figures. Fewkes in 1887 confirmed this view but did not add much to its substantiation owing to lack of material.

In the present paper Russo considers the formation of the blastula, the entoderm and the mesoderm in this species.

Cleavage gives rise to a very characteristic blastula having elongated cells surrounding a rather small cleavage cavity.

The inner part of each cell is made very opaque by a quantity of pigment which is thought to be related to the presence of food-yolk: the outer part of each cell is yellow and transparent. The blastula thus looks like that of Geryonia.

The inner pigmented part of each cell becomes divided from the outer part and the resulting gastrula has an ectoderm of transparent, elongated cells with large nuclei and an entoderm of smaller, rounded, pigmented cells.

He thus extends the occurrence of delamination to a new group. Following Brouer he attributes this mode of gastrulation to the conditions of development. "Everywhere when a free-swimming blastula is present we find unipolar entoderm formation, corresponding to the direction of swimming: everywhere when development goes on in a limited space we find multipolarity." This the author thinks is true of the Echinoderms as well as of the Coelenterates.

The proctodoeum and the archenteron are formed by the breaking down at a definite point, first of the ectoderm and then of the entoderm. After this the mesoderm appears: first as a heap of irregularly shaped cells on either side of the proctodoeum. These cells arise by delamination from the ectoderm and, pushing backward, nearly fill the whole cleavage cavity. They finally arrange themselves upon the ectoderm and the entoderm, like an epithelium, thus forming a single cavity, the coelom.—G. W. Field.

The Origin of the Sertoli's Cell.—It is now generally known that the seminiferous tubules of a mammalian testis contain two funda-

[1]Achille Russo: Zool. Anz. Nov. 16, 1891.

mentally different kinds of cells; 1. The sperm-producing cells; 2. The sperm-nursing cell. The latter have been called Sertoli's cells by v. Ebner, in honor of the discoverer: they are also known as; spermatoblasts (v. Ebner); copulation cells; supporting cells; *Fusszellen, Stützellen; cellules de sentien*, etc.

The sperm-producing cell is essentially migratory in habit and as soon as it attains a certain stage of growth it leaves the wall of the tubule and undergoes a manifold series of changes within the tubule.

In this respect the young sperm mother-cell offers a striking contrast to the young egg cell, which leads a sedentary life up to the last stage of maturity when it first becomes free by the rupture of the follicle.

The changes which the young spermatogonium undergoes after leaving the basement-membrane of the tubule are quite well understood. On the other hand, the history of the Sertoli's cell is not sufficiently known. The Sertoli's cell has a most characteristic appearance and is very easy to recognize by its comet shaped cytoplasm, by its large vesicular nucleus, and by its characteristic nucleolus. It is not likely that a single set of Sertoli's cells perform the nursing function for the several consecutive crops of spermatozoa. My conclusion, in regard to this point, as based on the study of human spermatogenesis, may be briefly stated as follows:—The sperm-nursing cell (the Sertoli's cell) in the seminiferous tubules of a mammal arises from a distinct anlage of its own, as the spermatozoan arises from the spermatogonium. In short, not only the two kinds of functional cells, —the sperm and its nurse—exist in the seminiferous tubule, but also the distinct antecedent cells for each of them; or more properly, the existence of two different kinds of cells in the functional seminiferous tubule is due to the existence of two entirely different kinds of antecedent cells. Just as the spermatogonia or the "Stammzellen" are the antecedent structure for the spermatozoa, so the small, stellate cells—*cellules étoilées* of Renson—found in the interstitial spaces of the spermatogonia are the antecedents of Sertoli's cells. The stellate cell stains quite differently from the adult Sertoli's cell, as the young spermatogonium stains differently from the adult spermatozoan. I have been able, however, to trace the series from the young stellate cell up to Sertoli's cell almost as completely as between the spermatogonium and the spermatozoan. The youngest spermatogonium stains quite differently from the youngest stellate cell, so that the difference between the two cells, the sperm and its nurse, begins extremely early. If they were derived from the same source, the differentiation in these

two directions must have taken place at the beginning of the embryonic history of the animal. My results therefore lend no support to the views in which Sertoli's cells are regarded as the modification of the sperm-producing cell proper or of its direct derivatives.

The differential staining was accomplished in a satisfactory manner by the use of two new aniline colors, viz: *Cyanine* and *Chromotrop. Erythrosine* has yielded also a very satisfactory result. The results of the application of these colors to the study of spermatogenesis and the differential staining of sexual cells after the manner of Auerbach, I shall report at no very distant future.—S. WATASE, Clark University, Worcester, Mass.

ENTOMOLOGY.[1]

A Spider Enemy of Oeneis semidea. — All butterflies seem to have enemies that prey upon them during some if not all stages of their existence, and *Oeneis semidea*, which lives on the top of our highest New England mountain, is no exception to the universal rule.

During a brief visit to Mt. Washington, N. H., during the summer of 1889 I was surprised while collecting on Semidea Plateau, as Mr. Scudder has very appropriately termed a favorite locality for this butterfly near the top of the mountain, to see great numbers of a dark bluish-black spider (*Pardosa albomaculata* Emerton) which seemed to be found everywhere, and was particularly noticeable along the carriage road leading from the lower end of this plateau to the summit. My first thought on seeing these spiders in such numbers was what were they doing at such an altitude, over 5000 feet; surely there were not sufficient flies at such an elevation to feed them, and in fact I saw none whatever; neither did I notice spider webs, and these would seem quite necessary were they feeding on flies. Therefore I took pains to learn, if possible, the reason of their being in that particular area and nowhere else observable on the mountain. I had noticed many dead and imperfect butterflies lying on the ground, especially along the roadway, but not suspecting the real cause, supposed they were killed by the passing of teams or exposure to the fierce cold winds which occasionally sweep across the mountain even in the summer time. It was not, however, until next to the last day of my stay on the summit that I discovered the true explanation for the great mortality among the butterflies and the presence of this peculiar spider.

[1]Edited by Prof. C. M. Weed, Hanover, N. H.

Upon the day in question, with the thermometer at 40° and a cold misty wind blowing from the North, I was coming down the road from the hotel to Semidea Plateau when I caught sight of a butterfly a few yards ahead, on the ground which was being blown sideways by the wind while attempting to walk. What was my surprise to see one of the spiders rush from behind a small stone and leap upon and fasten itself with tiger-like grip upon the chilled and almost helpless butterfly At that instant I realized the significance of the act, and the question was settled in my mind why these spiders were to be found in this inhospitable region. Securing both spider and butterfly for future use and to make sure that this was not an unusual occurrence I shortly afterward made several experiments by placing partially dead butterflies near different spiders to watch their actions, and invariably they rushed upon them in a most ferocious manner. With a thread attached to a butterfly I induced a spider to follow it at least a rod in his mad endeavor to obtain the coveted prize.

It is my opinion, although I have positive knowledge only in regard to the perfect insect, that this spider subsists almost entirely upon *Oeneis semidea* during its various stages. One always sees them searching about among the rocks or sedge, apparently hunting for the egg, larva or perfect insect in hiding, and even when it is so cold and damp that the butterflies are chilled and scarcely move, the spiders do not seem to be affected but act as if it was their golden opportunity to obtain a dinner, and search for it at that time with unusual vigor. As my time and means were limited perhaps it would be well for future collectors who visit this locality to study more closely and carefully this peculiar spider in this bleak and bare region. Perhaps, like the butterfly, this, too, is a remnant of a once widely disseminated species, but which with the receding glaciers found conditions and food favorable for its existence only on the tops of our highest mountains.—SHELLEY W. DENTON, Wellesley, Mass.

Biology of the Chalcididæ.—Mr. L. O. Howard[1] has published an extremely interesting paper upon a subject concerning which he speaks with the authority given by years of careful study. It consists of a general review of our present knowledge concerning the life histories of the interesting hymenopterous parasites of the family Chalcididæ. The scope of the discussion is indicated by the following list of the sub-headings: The insects and stages of insects infested by Chal-

[1]The Biology of the Hymenopterous insects of the family Chalcididæ, by L. O. Howard. Proc. U. S. Nat. Mus., No. 881.

cidids; How the Chalcidid larva lives; How fast does it develop; How the larva transforms; How many develop in a single host; Proportions of sexes in issuing; Phytophagic habit; Parthenogenesis; How large is the family.

Mr. Howard's conclusions concerning the number of species in the family will be a surprise to many entomologists. They indicate how much yet remains to be done in the field of descriptive entomology in America. The author says: "In this country (America, North of Mexico) the latest list (Cresson's, 1887) records only 413 species, while I have recorded (Bull. V, Div. Ent.), in addition to those, 128 species from Mexico and the West Indies. For the purpose of this paper I have gone carefully over the collection of the National Museum and estimate the number of species of this family contained in that one collection at something over 2000, nearly all from America, North of Mexico. According to my best judgment this represents a very small proportion of the species yet to be found within these geographical limits, as almost no effort at general collecting has been made, and these 2000 species are very largely the result of accidental breeding. When a single sweep of the beating net on the Department grounds at Washington will result in the capture of five new species what will be the result when the entire country shall have been collected over by sifting, beating and the many other devices known to experienced collectors? I fully believe that to estimate the number of species of this one family in North America as exceeding the number of described North American species of the entire order Hymenoptera would be far below the truth. When we consider, as shown in a previous section, that these small hymenopterous parasites live upon or within some one or several of the stages of perhaps the majority of insects of all orders, then we no longer wonder at their numbers or at the great variety exhibited among them."

The Gypsy Moth.—A recent issue of the *Salem* (Mass.) *Gazette* contains the following account of the Gypsy Moth developments in that region:

Amidst all the hue and cry against the importation of foreign contract laborers, foreign paupers and foreign fevers it is to be considered to what an extent this country has been victimized through the importation of foreign weeds, birds and bugs. A field of daisies may be an attractive sight from an æsthetic standpoint, but to the farmer it is simply a lot of undesirable white weed, spoiling a crop of good English hay. The little plant which rightfully bears the title of the royal

Plantagenets, and spreads its golden glory all over some of our neighboring hills, is practically a nuisance, and deserves its ignominious name of wood-wax, by which it is commonly known. These and the English sparrow are instances of unwise importation.

But the latest offender, and the prospect seems promising that he may prove the chiefest and worst, is the individual who first brought to this country a specimen of the gypsy moth. If he had taken the precaution to chloroform him—or her—or to impale the insect after the cheerful manner of his brother entomologists, the cause of science might have been enriched without danger to the cause of arboriculture. But the ambition of this collector vaulted above the low level of pin-stuck bugs. He would be the proud possessor of the only real live gypsy moth in America. He was for a time.

Then the moth, imbued with that new spirit of liberty which all other immigrants from monarchial tyranny are said to feel when they reach the home of the brave and the land of the free, just got away. It set up house-keeping on its own account and proceeded to raise a family. How well it succeeded in the latter operation is a matter upon which certain acts of the Legislature of Massachusetts and certain items of expenditure recited in the reports of the Auditor of the Commonwealth may throw some light.

The first instance of the appearance of the *Ocneria dispar*—this is the bug's company name—in the literature of the blue books, is at the head of chapter 95 of the Acts of 1890, wherein the Governor is authorized to launch a brand new commission on a long suffering public to consist of three suitable and discreet persons charged with the duty of preventing the spreading and securing the extermination of the gypsy moth.

The nameless individual who wrought the mischief by importing the progenitor of the race was protected by the constitutional prohibition of *ex post facto* laws from receiving a fit penalty for his dire offence; but it was provided that henceforth it should be unlawful for any person to knowingly bring the insect, or its nest, or its eggs within the Commonwealth, and that a fine of two hundred dollars or durance vile for sixty days should await the culprit convicted of breaking the laws.

Last year the Legislature repealed the act of 1890 but substantially re-enacted its provisions, except that it transferred the responsibility of selecting the suitable and discreet bug-hunters from the Governor to the State Board of Agriculture. Suitable and discreet persons cost something when these qualities are demanded by the Commonwealth.

They have cost so far an even hundred thousand dollars. Let it not be whispered in Gath that an extermination which exterminates would be undesirable for any such reason as that it would also exterminate the salaries. Governor Russell has just signed a new bill for seventy-five thousand dollars more, and forty men will immediately gird them for the fight.

And the end is not yet. Thirty towns and cities, covering an area of two hundred miles, have the prolific progeny of the unwelcome visitor already infested. Official circulars posted behind the Salem postoffice door impart the unwelcome intelligence that they are here.

If the ninety and nine moths are killed and the one that escapes becomes the happy parent of a quarter of a million or so of little gypsies, and this ratio of destruction and increase is maintained ad infinitum, where will the suitable and discreet men eventually be, and what will be left of the State Treasury but an empty chrysalis?

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

U. S. National Academy of Sciences.—This body met in Washington on April 18–21st for the transaction of business and the reading of papers.

The following papers were read:

The American Maar, G. K. Gilbert; The Form and Efficiency of the Iced Bar Base Apparatus of the U. S. Coast and Geodetic Survey, R. S. Woodward (Introduced by T. C. Mendenhall); On Atmospheric Radiation of Heat in Meteorology, C. Abbe; On the Deflecting Forces that Produce the Diurnal Variation of the Normal Terrestrial Magnetic Field, F. H. Bigelow (Introduced by C. Abbe); Abstract of Results from the U. S. Coast and Geodetic Survey Magnetic Observatory at Los Angeles, Cal., 1882–1889, part III.; Differential Measures of the Horizontal Component of the Magnetic Force, C. A. Schott; On the Anatomy and Systematic Position of the Mecoptera, A. S. Packard; On the Laws of the Variation of Latitude, S. C. Chandler; On the Causes of Variations of Period in the Variable Stars, S. C. Chandler; On the Force of Gravity at Washington, T. C. Mendenhall; On the Recent Variations of Latitude at Washington, T. C. Mendenhall; On the Acoustic Properties of Aluminum, with Experimental Illustrations, A. M. Mayer; Description of the Silver Haloid Molecule by Mechanical Force, M. Carey Lea (Introduced by G. F. Barker); On the Homologies of the Cranial Arches of the Reptilia,

E. D. Cope; On the Osteology of the Genus Anniella, E. D. Cope; The Astronomical, Geodetic, and Electric Consequences of Tidal Strains within an Elastic Terrestrial Spheroid, by C. Abbe; Asiatic Influences in Europe, by E. S. Morse; Exhibition of Chladni's Acoustic Figures Transferred to Paper without Distortion, by A. M. Mayer, and on Electrical Discharges Through Poor Vacua and on Coronoidal Discharges, by M. I. Pupin.

The following gentlemen were elected members: Carl Barns, physicist, of Washington; M. Carey Lea, of Boston, chemist; and S. F. Emmons, of Washington, geologist; no biologist was elected.

Academy of Natural Sciences, Philadelphia.—On Feb. 19th the new lecture hall of the Academy was opened. Dr. Harrison Allen lectured on the "Mechanism of the Mammalian Limb," which was richly illustrated with natural history specimens. Rev. Dr. McCook, in the absence of the president, General Wistar, made the address of the evening, on the opening of the new hall.

Among other things Dr. McCook said: "This building marks the culmination of a new life and policy which a few years ago was adopted by the Academy's administration. Professorships had been provided for in our constitution, but they were only high sounding titles. There were no men to occupy them. It was resolved that, first of all, the professorships should be filled, and that next, work should be given professors to do.

"Only a few years ago a few enthusiastic young professors were placed in the van of the new endeavor. Among them the late Carvill Lewis, Prof. Benjamin Sharpe and Prof. Angelo Heilprin. Prof. Brinton came in at a later date and Prof. J. Gibbons Hunt, the nestor of the faculty, contributed something by his admirable popular lectures before the section of biology and microscopy. The new departure was a substantial success.

"Long before the University Extension movement presented itself the Academy was working on the same lines. And the culmination of this work is this new hall which is now open for classes and courses of lectures.

"This, however, is but the vestibule of an unfinished building. The citizens of Philadelphia should hasten to the completion of the museum building of which this hall forms a part. Complete this building; give us money to endow richly the museum; set these eager hands and minds with all this machinery to work their best, and in twenty-

five years or less there will be no institution to which you may point with such proud satisfaction as this Academy of Natural Sciences."

Boston Society of Natural History.—April 20.—The following papers were read: Dr. John Murray, Some Recent Investigations into the Physical and Biological Conditions of the Lochs and Fjords of the West of Scotland; Mr. E. Adams Hartwell, An Elevated Pothole at Fitchburg, Mass; Mr. George H. Barton, Additional Notes on the Drumlins of Massachusetts.—SAMUEL HENSHAW, *Secretary pro tempore.*

The Biological Society of Washington.—April 16.—The following communications were read: Dr. C. W. Stiles, Notes on Parasites, *Tænia ovilla* in its relation to Blanchard's Classification; Mr. F. V. Coville, The Flora of the High Sierras of California; New Plants from California, Nevada, and Utah; Dr. Erwin F. Smith, A Review of Baillon's Botanical Dictionary; Mr. J. N. Rose, Mexican Leguminosæ with Notes on Dr. Palmer's collection.

April 30.—The principle paper of the evening was The Distribution of Land, Water and Ice on this Continent in Later Geological Periods, by Prof. W. J. McGee. Other communications were: Dr. Erwin F. Smith, The Relation of Plants to the Soil. (Illustrated); Mr. Charles Hallock, Where Salt-water Fishes Hide; Results of Deep-water Seining.—FREDERIC A. LUCAS, *Secretary.*

Proceedings of the Natural Science Association of Staten Island.—April 9.—Meeting called to order at 8.30 o'clock. In the absence of the president, Mr. Arthur Hollick was elected chairman *pro tem.*

Mr. L. P. Gratacap submitted the following additional facts in regard to the fossil leaf exhibited at the last meeting.

The specimen was found at Richmond valley, (not at Richmond as previously reported,) a few rods north-east of the railroad station, in an excavation made for a cellar. It was originally part of a larger slab, about 1½ feet square, which seemed to be imbedded in the Drift of the hillside. No indication of any stratum or layer of material similar to the rock was noted. It was found about four years ago, by Mr. Mesner, from whom the above facts were obtained.

Mr. Hollick remarked that the locality, as corrected, removed one of the elements of improbability, which had caused the specimen to be looked at with suspicion, and that it had now been brought within

the area where such a leaf might be looked for. The specimen apparently belongs to the Cretaceous genus *Grewiopsis*, and is contained in a sandstone similar to that of the Dakota group. How it came to be in the position where it was found is more or less problematic, but similar sandstone is found associated with the Cretaceous clays, and it may have been originally in one of these layers, which subsequently suffered erosion and transportation by glacial action, as we know to have been the case with other Cretaceous material in the neighborhood. If such specimens are ever found in place the probabilities are that they will be located in the sandstone layers overlying the Cretaceous clays to the north and west of Richmond Valley station.

Mr. Joseph C. Thompson exhibited a skin of a large muskrat, which was killed in the basement of his residence, at Clifton, on the morning of April 1st.

Mr. Hollick showed a diorite pebble, with a thin section of the same for microscopic examination. The specimen was found in the Drift at Princes Bay and attracted attention from its coarse porphyritic structure, so different from that of the close-grained diabase common in the vicinity. The thin section submitted to microscopic examination showed it to be a diorite, consisting of hornblende and plagioclase feldspar, the former partly altered to green actinolite. A similar rock was found in a place by Mr. Gratacap, on Lambert's Lane, Northfield, and was described by him in the Proceedings for December 12th, 1891.

Mr. Hollick referred to the memorandum in regard to a nest of the Barred Owl having been found near Bull's Head, as noted in the Proceedings of April 11th, 1891, and stated that the birds had again nested in the same tree. On March 12th of the present year a set of three eggs were found by Mr. Charles R. Harte. The tree is located in the same patch of woodland in which the Red Shouldered Hawk nests every year.

SCIENTIFIC NEWS.

Mr. Timothy Hopkins has made provision for the endowment and maintenance of the seaside laboratory at Pacific Grove recently established under the auspices of the Leland Stanford Junior University, mention of which was made in the last number of this journal. It is intended to make this a place for original investigation of the habits, life history, structure and development of marine animals and plants and to carry on work here similar to that which has made the aquarium at Naples known all over the world.

The Hopkins Laboratory will be under the general direction of Profs. Gilbert, Jenkins and Campbell. It will be open during the summer vacation and its facilities will be at the disposal of persons wishing to carry on original investigations in biology as well as of students and teachers interested in that line of subjects. It will be fully provided with aquaria while microscopes, microtomes and other instruments necessary for investigations will be taken from the laboratories of the University.

The Botanical Club of San Francisco has 155 members. It holds meetings on the first and third Mondays of each month in the lecture hall of the California Academy of Sciences. The officers for the present year are: President, Dr. Douglass H. Campbell; Vice President, Mrs. S. W. Dennis; Secretary, Frank H. Voslet; Treasurer, Miss A. M. Manning; Librarian, Mrs. S. W. Burtchaell; Curator, Miss E. B. Falkenan; Councillors, Mrs. L. D. Emerson, C. C. Riedy, and Miss C. H. Hittell.

The announcement is made that Grevillea, the well-known journal of cryptogamic botany, will cease publication with the close of the twentieth volume, unless other hands than those of its present editor, Mr. M. C. Cooke, take it up and carry it on.

F. B. Caulfield, an entomologist of Montreal, died in that city March 15, 1892.

Dr. Unna offers yearly a prize of Mark 300 for dermatological essays. This year the subject is "Schwund und Regeneration des elastischen Gewebes der Haut unter verschiedenen pathologischen

Verhältnissen." The essay must reach the publication office of Leopold Voss in Hamburg by the beginning of December, 1892. The judges this year are Profs. Klebs and Hoyer.

Mr. Godefroy Lunel died in Geneva, Nov. 17, 1891. His place as director of the Natural History Museum there has been filled by the nomination of Dr. Maurice Bedot.

The Natural History Society of Buda-Pesth, Austria, is said to have a membership rising to 7800.

Prof. H. S. Williams of Cornell, has been elected professor of geology at Yale University, to take the place of the Veteran James D. Dana. Prof. Dana still retains his connection with the University and will do some lecturing, but advancing years do not allow him to devote himself as before to class work.

Mr. W. M. Goldthwaite of New York City has started a new magazine entitled "Minerals" the scope of which is indicated by the name.

A Correction.—The article entitled "Abnormal Duplication of the Urosonic in Rana catesbiana" in this journal for August 1891, should have been credited to Wm. L. Sherwood, 199 West 134th St., New York City.

The Rev. C. J. Ball, M.A., continues to advance arguments in support of the identity of the ancient Accadian ideograms with early Chinese signs, in a series of interesting papers read before the Society of Biblical Archeology, and printed in the Proceedings of the Society. The Accaians were the original inhabitants of Assyria and Babylonia prior to thed incursion of the Semitic race. By some writers they are credited with the invention of that cuneiform or arrow-headed and wedge-shaped script, from which M. De Lacouperie maintains the early Chinese characters were derived, being cuneiform merely transferred from left to top, sometimes from an upright to a horizontal position.

Mr. Stewart Culin, of Philadelphia, the author of some able papers on "The Secret Societies of the Chinese in America," and "Chinese Games with Dice," has just issued another agreeably written memoir, "On the Gambling Games of the Chinese in America." It appears in the fourth number of the first volume of the Series in Philology, Literature, and Archeology of the publications of the University Press

of Pennsylvania,—a very promising series of well-printed little monographs on various subjects, issued at a most reasonable price. The game of fan t'an, or "that of repeatedly spreading out," is played in a cellar or basement, a sentinel being stationed without the door to give notice of the approach of danger. A second, of which the name Pak kop piu signifies "the game of the white pigeon ticket," is played in attics, pigeons being formerly employed to convey the tickets and winning numbers from the offices to their patrons. This is really a kind of lottery, and the assistants who prepare the papers are dignified with the title of Sin' shang, literally "first born" the equivalent to "Mr.," and the only title of respect used among the Chinese laborers in America. Gamblers of this nationality, like all others, are very superstitious, avoid the use of certain colors, and eat in silence the suppers provided by the gambling companies. They propitiate the gods with liberal offerings, and sometimes erect shrines in recognition of a successful *coup*. Their love of games of chance, in Mr. Culin's opinion, tends to give permanency to the Chinese settlements in America, as they cluster round the gambling places in the large cities.

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THE CONTEMPORARY EVOLUTION OF MAN.

By HENRY FAIRFIELD OSBORN.

THE CARTWRIGHT LECTURES FOR 1892, No. I.[1]

In the past decade of practical research and speculation in biology two subjects have outstripped in interest and importance the rapid progress all along the line. These are, first, the life-history of the reproductive cell from its infancy in the ovum onward, and second, the associated problem of heredity, which passes insensibly from the field of direct observation into the region of pure speculation.

As regards the cell it was generally believed that the nucleus was an arcanum into the mysteries of which we could not far penetrate; but this belief has long been dispelled by the eager specialist, and it is no exaggeration to say that we now know more about the meaning of the nucleus than we did about the entire cell a few years ago. At that time the current solution of the heredity problem was a purely formal one; it came to the main barrier, namely, the relation of heredity and evolution to the reproductive cells, and leapt over it by the postulate of Pangenesis. The germ-cell studies of Balfour, Van Beneden, the Hertwig brothers, Weismann, Boveri and others have gradually led us to hope that we shall some day trace the con-

[1]Delivered before the Alumni of the College of Physicians and Surgeons, New York, February 12th, 19th, 26th.

nection between the intricate metamorphoses in these cells and the external phenomena of heredity, and more than this, to realize that the heredity theory of the future must rest upon a far more exact knowledge than we enjoy at present of the history of the reproductive cell both in itself and in the influence which the surrounding body cells have upon it.

These advances affect the problem of life and protoplasm, whether studied by the physician, the anthropologist or the zoologist, thus concentrating into one focus opinions which have been formed by the observation of widely different classes of facts. As each class of facts bears to the observer a different aspect and gives him a personal bias, the discussion is by no means ironical, and it is our privilege to live through one of those heated periods which mark the course of every revolution in the world of ideas. Such a crisis was brought about by the publication of the theory of Darwin, in 1858, and after subsiding has again been roused by Weismann's theory of heredity, published in 1883.

This is the situation I have ventured to present to you as Cartwright lecturer, not, of course, without introducing some conclusions of my own, which have been derived from vertebrate palæontology, but which I shall direct mainly upon human evolution.

So far as theories need come before us now, remember that Lamarck (1792) attributed evolution to the hereditary transmission to offspring of changes (acquired variations) caused by environment and habit in the parent. Darwin's latest view was that evolution is due to the Natural Selection of such congenital variations as favored survival, supplemented by the transmission of acquired variations. Weismann entirely denies the transmission of acquired variations or characters, and attributes evolution solely to the natural selection of the individuals which bear the most favorable variations of the germ or reproductive cells. We must, therefore, clearly distinguish between "congenital variations" which are part of our inheritance and "acquired variations" which are due to our life-habits; the question is, Are the latter transmitted?

Significance of Anomalies.—At the outset I would emphasize the extreme complexity of evolution by a few words upon Variation, or in terms of medical science, upon anomalies.

When we speak of a part as "anomalous" we mean that it varies at birth from the ordinary or typical form—it may be minute, as the small slip of a tendon, or large, as the addition of a complete vertebra to the spinal column. Wood has found that in the muscular system alone there are nine anomalies in the average individual. It is clear that the evolution of a new type, so far as the muscular system is concerned, must consist in the *accumulation of anomalies in a certain definite direction by heredity.* Thus the anomalous condition of one generation may become the typical condition of a very much later generation, and we observe the paradox of a typical structure becoming an anomaly and an anomalous structure becoming typical; for example, the supracondylar foramen of the humerus was once typical; it is now anomalous; the retardation in development of the wisdom tooth was once anomalous; it is now typical.

The same principle applies to races which are in different stages of evolution; an anomaly in the white, such as the early closure of the cranial sutures, is normal in the black. Now the deductions of the Weismann school of evolutionists seem to be founded upon the principle "*de minimis non curat lex;*" that we need only regard such major variations as can, *ex hypothesi*, weigh in the scale of survival. Against this I urge that we must regard the evolution of particular structures, the components of larger organs, the separate muscles and bones for example, for the very reason that while in some cases they play a most humble *rôle* in our economy we can prove beyond a doubt that they are in course of evolution. Minor variations in foot structure, which are possibly of vital importance to a quadruped whose very existence may depend upon speed, sink into obscurity as factors in the survival of the modern American.

The evolution of man in the most unimportant details of his structure promises, therefore, to afford a far more crucial test of the Lamarckian *vs.* the pure Natural Selection theory,

than in the domain of his higher faculties, for the reason that Selection may operate upon variations in mind, while it taxes our credulity to believe it can operate upon variations in muscle and bone. This is my ground for selecting the skeleton and muscles for the subject of the introductory lecture. Nevertheless, let us review variation in all its forms in human anatomy before forming an opinion. Let us remember, too, that congenital and acquired variations are universal as necessities of birth and life; they are exhibited in the body as a whole—in its proportions, in the components of each limb, finally in the separate parts of each component, as in the divisions of a complex muscle. Thus the possibilities of transformism are everywhere. What is the nature and origin of congenital variations? Their causes? Do they follow certain directions? Do they spring from acquired variations by heredity? These are some of the questions which are still unsettled.

But striking as are the anomalies from type, the repetitions of type as exhibited in atavism and normal inheritance are still more so, and equally difficult to explain. Therefore our theory must provide both for the observed laws of repetition of ancestral form and the laws of variation from ancestral form, as the pasture-land of evolution. Add to these, that for a period in each generation this entire legislation of nature is compressed into the tiny nucleus of the fertilized ovum, and the whole problem rises before us in the apparent impregnability which only intensifies our ardor of research.

The anthropologists and anatomists have enjoyed a certain monopoly of *Homo sapiens*, while the biologists have directed their energies mainly upon the lower creation. But under the inspiring influences of the Darwinian theory these originally distinct branches have converged, and as man takes his place in the zoological system, comparative anatomy is recognized as the infallible key to human anatomy.

For our present purpose we must suppress our sentiment at the outset and state plainly that the only interpretation of our bodily structure lies in the theory of our descent from some early member of the primates, such as may have given rise

also to the living Anthropoidea. This is also the only tenable teleological view, for many of our inherited organs are at present non-purposive, in some cases even harmful, as the appendix vermiformis.

From the typical mammalian stand-point man is a degenerate animal; his senses are inferior in acuteness; his upright position, while giving him a superior aspect, entails many disadvantages, as recently enumerated by Clevenger,[1] for the body is not fully adapted to it; his feet are not superior to those of many lower Eocene plantigrades; his teeth are mechanically far inferior to those of the domestic cat. In fact, if an unbiased comparative anatomist should reach this planet from Mars he could only pass favorable comment upon the perfection of the hand and the massive brain! Holding these trumps, man has been and now is discarding many useful structures. I refer especially to civilized man, who is more prodigal with his inheritance than the savage. By virtue of the hand and the brain he is, nevertheless, the best adapted and most cosmopolitan vertebrate. The man of Néanderthal or Spy, with retreating forehead and brain of small cubic capacity[2] was limited both in his ideas and his powers of travel, yet he was our superior in some points of osteological structure. But the period of Néanderthal was recent compared with that in which some of our rudimentary organs were serviceable, such as the vermiform appendix or the panniculus carnosus[3] muscle. These rudiments, in turn, are neogenetic when we consider the age of the two antique sense organs in the optic thalamus, the remnants of the median or pineal eye and the pituitary body, both of which were undoubtedly present, and probably useful, in the recently discovered Silurian fishes!

[1]Disadvantages of the Upright Position, article in AMERICAN NATURALIST, 1884, p. 1.

[2]The remarkable skulls and skeletons which have recently been discovered at Spy remove all doubts as to the normal *i. e.*, racial character of the famous Néanderthal skull, which were entertained by Quatrefages and others. See Fraipont and Lohest, Archives de Biologie, 1887, p. 697.

[3]This is an epidermal or twitching muscle in the quadrupeds.

I mention these vestiges of some of the first steps in creation to illustrate the extraordinary conservative power of heredity (which is even more forcibly seen in our embryological development), partly also to show how widely our organs differ in age. Galton has compared the human frame to a new building built up of fragments of old ones; extend this back into the ages and the comparison is complete.

Development, Balance, Degeneration.—It is probable that none of our organs are absolutely static and that the apparent halt in the development of some is merely relative, as where a fast train passes a slow one. The numerous cases of arrested evolution in nature are always connected with fixity of environment, an exceptional condition with man, and we have ample evidence that some organs are changing more rapidly than others.

Adaptation to our changing circumstances is mainly effected by the simultaneous development and degeneration of organs which lie side by side, as in the muscles of the foot or hand; in terms of physiology, we observe the hypertrophy of adaptive organs and atrophy of inadaptive or useless organs. This compensating readjustment, whereby the sum of nutrition to any region remains the same during redistribution to its parts, may be called metatrophism. It is the gerrymander principle in nature.

In practical investigation it is very difficult in many cases to determine whether an organ is actually developing or degenerating at the present time; although its variability or tendency to present individual anomalies indicates that some change is in progress. I may instance the highly variable peroneus tertius muscle (Wood). The rise or fall of organs is so constantly associated with their degree of utility that in each case the doubt can be removed by a careful analysis of the greater or less actual service rendered by the part in question. Apart from the question of causation it is a fixed principle that a part degenerating by disuse in each individual will also be found degenerating in the race.

Degeneration is an extremely slow process; both in the muscular and skeletal systems we find organs so far on the down grade that they are mere pensioners of the body, drawing pay (*i. e.*, nutrition) for past honorable services without performing any corresponding work—the plantaris and palmaris muscles for example. Of course an organ without a function is a disadvantage, so that the final duty of degeneration is to restore the balance between structure and function by placing it *hors de combat* entirely. One symptom of decline is variability, in which the organ seems to be demonstrating its own uselessness by occasional absence. As Humphrey remarks: "The muscles which are most frequently absent by anomalies are in fact those which can disappear with least inconvenience, either because they can be replaced by others or because they play an altogether secondary *rôle* in the organism." The stages downward are gradual; the rudiment becomes variable as an adult structure, then as a fœtal structure; the percentage of absence slowly increases until it reappears only as a reversion; finally the part ceases even to revert and all record of it is lost. This long struggle of the destructive power of degeneration, which you see is essentially an adaptive factor, against the protective power of heredity is the most striking feature of the law of Repetition. (See Galton's similar principle of Regression in Anthropology).

A careful study of our developing, degenerating, rudimental and reversional organs amply demonstrates that man is now in a state of evolution hardly less rapid, I believe, than that which has produced the modern horse from his small five-toed ancestor. As far as I can see the only reason why our evolution should be slower than that of the ancient horse is the frequent intermingling of races, which always tends to resolve types which have specialized into more generalized types. Wherever the human species has been isolated for a long period of time divergence of character is very marked, as will be seen in some of the races I refer to below.

To lighten the long catalogue of facts, gathered from many authors, I shall frequently allude to *habit*, but will ask you to consider it for the time as associational rather than casual.

Pouchet says: "Man is a creature of the writing-table and could only have been invented in a country in which covering of the feet is universal;" he should have added the "eating-table." From the average man our fashions and occupations demand the play of the forearm and hand, the independent and complex movements of the thumb and finger; the outward turning of the foot in walking. These are some of the most conspicuous features of modern habit.

The Skeletal Variations.[1]—In a most valuable essay by Arthur Thomson upon "The Influence of Posture on the Form of the Articular Surfaces of the Tibia and Astragalus in the Different Races of Man and the Higher Apes,"[2] we find clearly brought out the distinction between congenital variations and those which may be acquired by prolonged habits of life. It is perfectly clear from this investigation that certain racial characters, such as "platycnemism" or flattened tibia, which have been considered of great importance in anthropology, may prove to be merely individual modifications due to certain local and temporary customs. Thomson's conclusions are that the tibia is the most variable in length and form of any long bone in the body. Platycnemia is most frequent in tribes living by hunting and climbing in hilly countries, and is associated with the strong development of the tibialis posticus. The great convexity of the external condyloid surface of the tibia in savage races appears to be developed during life by the frequent or habitual knee flexure in squatting; it is less developed where the tibia has a backward curve and is independent of platycnemia. Another product of the squatting habit is a facet formed upon the neck of the astragalus by the tibia. This is very rare in Europeans; it is found in the gorilla and orang, but rarely in the chimpanzee. We must therefore be on our guard to distinguish between congenital or hereditary skeletal characters which are fundamental and "acquired" skeletal variations which may not be hereditary. The latter

[1]For recent general articles see Blanchard, L'Atavisme chez l'Homme, Rev. de Anthrop. 1885, p. 425; and Baker, The Ascent of Man, Proceedings of the American Association for the Advancement of Science, 1890.

[2]Journal of Anatomy and Physiology, 1889, p. 617.

are of questionable value in tracing lines of descent, if not actually misleading; on the other hand, the teeth, as shown by Cope in his essay on "Lemurine reversion in human dentition," have distinct racial patterns and are reliable indices of consanguinity because their form cannot be modified during life.

The main features of present evolution in the backbone are the elaboration of the spines of the cervical vertebræ, the increase of the spinal curvatures, the shortening of the centra of the lumbar vertebræ and shifting of the pelvis upward, whereby a lumbar vertebra is added to the sacrum and subtracted from the dorso-lumbar series.

Cunningham[1] has found that the division of the neural spines in the upper cervical vertebræ distinguishes the higher races from the lower. The spine of the axis is always bifid, but the spines of the cervicals three, four and five are also, as a rule, bifid in the European, while they are single in the lower races. The same author shows[2] that the bodies of the lumbar vertebræ are altering, by widening and shortening, to form a firmer pillar of support, with a compensating increase in the length of the intervertebral cartilages. In the child the vertebræ present more nearly their primitive elongate compressed form. With this is associated an increase of the forward lumbar curvature (Turner);[3] the primitive (*i. e.*, Simian) curve was backward; even in the negroes the collective measurement of the posterior faces of the five lumbars is greater than the anterior, in the proportion of 106 to 100; whereas in the white the collective anterior faces exceed the posterior in nearly the same proportion—100 to 96.

The lower region of the back is also the seat of one of the most interesting and important of the changes in the body, namely, the correlated evolution of the inferior ribs, the lumbar vertebræ and the pelvis—to which embryology, adult and comparative anatomy and reversion all contribute their quota of proof. In most of the anthropoid apes, and therefore pre-

[1]Ibid., 1886, p. 636.
[2]Journal of Anatomy and Physiology, 1890, p. 117.
[3]Ibid., 1887, p. 473.

sumably in the pro-anthropos, there are thirteen complete ribs and four lumbar vertebræ, while man has twelve ribs and five lumbars. Thus we may consider the superior lumbar of adult man as a ribless dorsal; not so in the human embryo, however, for Rosenberg[1] has found a cartilaginous rudiment of the missing 13th rib upon the so-called first lumbar. Atavism contributes an earlier chapter in the history of this region, for Birmingham[2] reports, out of fifty cases examined in one year, two in which there were six lumbars, and in each the 13th rib was well developed; this is an interesting example of "correlated reversion," for as the pelvis shifted downward to its ancestral position upon the 26th vertebra the 13th rib was also restored. The other ribs are in what the ancients styled a "state of flux;" our 8th rib has been so recently floated from the sternum that, and according to Cunningham,[3] it reverts as a true rib in twenty cases out of a hundred, showing a decided preference for the right side. Regarding also the occasional fusion of the 5th lumbar with the sacrum and the unstable condition of the 12th rib, which is, by variation rudimentary or absent, Rosenberg makes bold to predict that in the man of the future the pelvis will shift another step upward to the 24th vertebræ and we shall then lose our 12th rib. The upright position and consequent transfer of the weight of the abdominal viscera to the pelvis may be considered the habit associated with this reduction of the chest; at all events, in the evolution of quadrupeds there is a constant relation of increase between the size of the posterior ribs and the weight of the viscera, until the rib-bearing vertebræ rise to twenty and the lumbars are reduced to three.[4] It would be interesting to note the condition of the ribs in some of the large-bellied tribes of Africans in reference to this point.

The coccyx has naturally been the center of active search for the missing flexible caudals. As is well known, the adult coccyx contains but from three to five centers, while the embryo contains from five to six. Dr. Max Bartels has made "Die geschwänzten Menschen" the subject of an exhaustive

[1]Morph. Jahrb., 1876.
[2]Journal of Anatomy and Physiology, 1891, p. 526.
[3]Ibid., 1890, p. 127.
[4]In the elephant and rhinoceros.

memoir upon cases of the reversion of the tail, while Testut records all the primitive tail muscles in various stages of reversion. Watson reports that the curvatores coccygia (-depressores caudæ) only occur in 1 in 1000 cases.

This suggests a moment's digression to consider the different phases of reversion. The 13th rib recurs by what Gegenbaur[1] calls "neogenetic reversion," for it is simply the anomalous adult development of an embryonic rudiment. Under neogenetic reversions many authors also include cases of the "arrested development," or persistence of an embryonic condition to adult life, such as the disunited odontoid process of the axis vertebra, which happens to repeat a very remote ancestral condition. I think such cases may illustrate a reversional tendency, although many cases of arrested development, such as anencephaly, have no atavistic significance whatever.[2] More rare and far more difficult to explain are the "palæogenetic reversions," in which the anomaly, such as the supracondylar foramen, reverts to an atavus so remote that the rudiment is not even represented in the embryo.

The features of skull development are primarily the increase of the cranium and the late closure of the cranial sutures in contrast with the more complete and earlier closure of the facial sutures.

So far as I can gather this seems to be another region where the white and colored races present reversed conditions; the early closure and arrest of brain development in the negroes is well known; the later closure among the whites is undoubtedly an adaptation to brain growth. In his valuable statistics upon the Cambridge students Galton says: "Although it is pretty well ascertained that in the masses of population the brain ceases to grow after the age of nineteen, or even earlier, it is by no means the case with university students. In high honor men headgrowth is precocious, their heads predominate over the average more at nineteen than at twenty-five."

Many of the cases of arrested closure of facial sutures are reversional, as they correspond with the adult condition of

[1]Morph. Jahrb., Bd. vi, p. 585.

[2]Anencephaly, it should be said, is frequently associated with numerous reversions.

other races, such as the divided malar or os Japonicum. The human premaxillary, a discovery with which Goethe's name will always be associated, is sometimes partially, more rarely wholly, isolated; it is late to unite with the maxillary in the Australians, and has been reported entirely separate in a New Caledonian child (Deslongchamps) and in two Greenlanders (Carus). The orbito-maxillary frontal suture, cited by Turner as a reversion to the pithecoid condition, is believed by Thomson,[1] after the examination of one thousand and thirty-seven skulls, to be merely an accidental variation, without any deeper significance. The development of the temporal bone from two centers, observed by Meckel, Gruber and many others, is considered by Albrecht a reversion to the separate quadrate of the sauro-mammalia. This I think is in the highest degree improbable (see "Limits of Reversion"). The open cranial and closed facial sutures are apparently associated with our increasing brain action and decreasing jaw action; in one case the growth is prolonged and the sutures are left open, in the other the growth is arrested and the sutures are closed.

Is the lower jaw developing or degenerating? This question has recently been the subject of a spirited controversy between Mr. W. Platt Ball,[2] representing the Weismann school, and Mr. F. Howard Collins,[3] supporting Herbert Spencer's view that a diminishing jaw is one of the features of our evolution which can only be explained by disuse. Mr. Collins finds that, relatively to the skull, the mass of the recent English jaw is one-ninth less than that of the ancient British, and roughly speaking, half that of the Australian. He appears to establish the view that the jaw is diminishing.

Closely connected with this is the evolution of the teeth; how are they tending? This we will consider below.

Variations of the Teeth.—Flower[4] has shown, as regards the length of our molar series, that we, together with the ancient

[1]Journal of Anatomy and Physiology, 1890, p. 348.
[2]Are the Effects of Use and Disuse Inherited? Nature Series, 1890.
[3]The Lower Jaw in Civilized Races, 1891.
[4]Journal of the Anthropological Institute, 1880.

British and Egyptians, belong to a small-toothed or "microdont" race; the Chinese, Indians (North American), Malayans and Negroes in part are intermediate or "mesodont," while the Andamanese, Melanasions, Australians and Tasmanians are "macrodont." While undersize marks the molars as a whole the wisdom tooth is certainly in process of elimination; it has the symptoms of decline; it is very variable in size, form and in the date of its appearance; is often misplaced, and is not uncommonly quite rudimentary (Tomes).[1] Here is another instance where the knife-and-forkless races reverse our degeneracy, for in them not only is the last normal molar (m. 3) large and cut long before the traditional years of discretion, but in the first two lower molars are found two intermediate cusps (Tomes)[2] which are variable or absent in us (Abbott); moreover, in the macrodont races a surplus molar[3] (m. 4) is sometimes developed. Mummery reports nine such cases among three hundred and twenty-eight West Africans (Ashantis). As an instance of associated habit I may here mention that Dr. Lumholtz, the Australian explorer, informs me that in adult natives the teeth are worn to the gum; in the absence of tools they are used in every occupation, from eviscerating a snake to cutting a root. A tour of inspection through any large collection of skulls brings out the contrast between the sound and hard-worn molars of the savage and the decayed and little-worn molars of the white.

Upon the descent theory the reduction of teeth in the progenitor of man began as far back as the Eocene period, for not later than that remote age do we find the full complement of three incisors and four premolars in each jaw; now there are but two remaining of each. Baume, a high authority, believes he has discovered eleven cases of a rudimental reversion of one of these lost premolars[4] not cutting the jaw. Not infrequently both these missing teeth occur by reversion! It is

[1]Dental Anatomy, p. 416.

[2]Op. cit., p. 416.

[3]This tooth has been found in several other macrodont tribes (Australians, Tasmanians, Neo-Caledonians), Fontan.

[4]Odontologische Forschungen, p. 268. This rudiment is found between the first and second normal premolars.

difficult to conceive of reversion to such a remote period, yet it is supported by other evidence. An embryonic third incisor has, I believe, been discovered. As long ago as 1863 Sedgwick[1] recorded a case of six upper and lower incisors in both jaws, and appearing in both the milk and permanent dentitions; this anomaly was inherited from a grandparent, a striking instance of hereditary reversional tendency. We might consider that these cases of supernumerary teeth belonged in the same category as polydactylism or additional fingers, which are not atavistic, but for the fact that they do not exceed the typical ancestral number, whereas the fingers do.

We owe to Windle[1] a careful review of the incisor reversions in which he shows that the lost incisors reappear more frequently in the upper than the lower jaw (coinciding with the fact that the lower teeth were the first to disappear in the race); he considers that the lost tooth was the one originally next the canine, and concludes by adding our present upper outer incisor to the long list of degenerating organs.[3] He supports this statement by measurements and by citing cases in which it has been found absent. Yet the reduction of the jaws is apparently outstripping that of the teeth, if we can judge from the frequent practice among American dentists of relieving the crowded jaw by extraction.

We now turn to the arches and limbs. Flower has pointed out that the base of the scapula is widening in the higher races, so that the "index," or ratio of length to breadth is quite distinctive. Gegenbaur associates this with the development of the scapulo-humeral muscles and the greater play of the humerus as a prehensile organ.

In general, the arm increases in interest as we descend toward the hand, both in the skeleton and musculature, because here we meet with the first glimpses of facts which enable us to form some estimate of the rate of human evolution. The well-known humeral torsion (connected with

[1]British and Foreign Medico-Chirurgical Review, 1863.

[2]Journal of Anatomy and Physiology, 1887, p. 85.

[3]Baume believes that the missing incisor is the primitive median one, while Turner believes it is the second. The fossil record supports Windle.

increased rotation) ascends from 152° in the polished stone age to 164° in the modern European. The intercondylar foramen or perforation of the olecranon fossa is exceptionally well recorded;[1] it is found in thirty per cent. of skeletons of the reindeer period; in the dolmen period it fell to twenty-four per cent.; in Parisian cemeteries between the fourth and tenth centuries it is found in 5.5 per cent.; it has now fallen to 3.5 per cent. The condylar foramen, occasionally forming a complete bridge of bone above the inner condyle and transmitting the median nerve and brachial artery, is known as the "entepicondylar" foramen in comparative anatomy, and is one of the most ancient characters of the mammalia; it reverts palæogenetically in one per cent. of recent skeletons, but much more frequently in inferior races (Lamb). In the wrist-bone is sometimes developed another extremely old structure—the os centrale. Gruber[2] reported its recurrence at .25 per cent. approximately. This is a case of neogenetic reversion, for Leboucq[3] shows that there is a distinct centrale in every human carpus in the first part of the second month, which normally fuses with the scaphoid by the middle of the third month.

The divergence of the female from the male pelvis is an important feature of our progressive development; it is proved by the fact that as we descend among the lower races it becomes increasingly difficult to distinguish the female skeleton from the male, for the pelves of the two sexes are nearly uniform. Here it seems to me is a most interesting problem for investigation. Arbuthnot Lane's[3] views of the mechanical causes of this divergence, which are strongly Lamarckian, may be weighed with the theory of survival of the fittest, for a large female pelvis is perhaps the best example that can be adduced of a skeletal variation which would be preserved by natural selection for reasons which are self-evident. The third trochanter of the femur is believed by Professor Dwight,[4] of

[1]See Blanchard, op. cit., p. 450.
[2]Virchow's Archiv, 1885, p. 353.
[3]Ann. de la Soc. de Med. de Gand, 1884.
[3]Journal of Anatomy and Physiology, 1888, p. 214.
[4]Ibid., 1890, p. 61.

the Harvard Medical School, to be a true reversion (one per cent.) in our race and not an acquired variation, as it is very frequently found among the Sioux (fifty per cent.), Laplanders sixty-four per cent., and Swedes thirty-seven per cent.; like the condylar foramen it is an ancient mammalian character.

The foot is full of interest in its association of degeneration and development with our present habits of walking; the great toe is increasing and the little toe diminishing, causing the oblique slope from within outward which is in wide contrast with the square toes in the infant or in the lower races. In many races the second toe is as long as the first, and the feet are carried parallel instead of the large toe turning out. If anyone will analyze his sensations in walking, even in his shoes, he will be conscious that the great toe is taking active part in progression, while the little toe is passive and insensitive. We are not surprised, therefore, to learn from Pfitzner[1] that we are losing a phalanx, that in many human skeletons (41.5 per cent. in women and thirty-one per cent. in men) the two end joints of the little toe are fused. The fusion occurs not only in adults but between birth and the seventh year, and in embryos of between the fifth and seventh month. The author does not attribute this to the mechanical pressure of tight shoes because it is found in the poorer classes. He considers it the first act of a total degeneration of the fifth toe.

Variations in the Muscles.—The evolution of the muscles of the foot looks in the same direction.

As you know, the large toe in many of the apes is set at an angle to the foot and is used in climbing. It is still employed in a variety of occupations by different races. According to Tremlett[2] the celebrated great toe of the Annamese, which normally projects at a wide angle from the foot, is contemptuously mentioned in Chinese annals of 2285 B.C., the race being then described as the "cross-toes." The long flexor of the hallux is apparently degenerating, showing a tendency to

[1]See Humboldt, 1890; also Nature, 1890, p. 301.

[2]Journal of the Anthropological Institute, 1880, p. 461.

fuse with the flexor communis: the abductors and adductors of this toe are also degenerating, the latter being proportionately large in children (Ruge). The little toe exhibits only by reversion its primitive share of the flexor brevis (Gegenbaur); more frequently it varies in the direction of its future decline by losing its flexor brevis tendon entirely. Two atavistic muscles, the abductor metatarsi quinti[1] (always present in the apes), and the peroneus parvus (Bischoff), also point to the former mobility of the outer side of the foot. In general the bones of the foot are developing on the inner and degenerating on the outer side, with loss of the lateral movements of the hallux and of all independent movements in the little toe. The associated habit is that the main axis of pressure and strain now connects the heel and great toe, leaving the outer side of the foot comparatively functionless.

The variations in the muscular system mark off more clearly the regions of contemporary evolution, and therefore are even more instructive than those in the skeleton. Muscular anomalies have, however, never been adequately analyzed. Even the remarkable memoir of M. Testut, "Sur les anomalies musculaires," is defective in not clearly distinguishing between variations which look to the future, those which revert to the past, and those which are fortuitous, for the author is strongly inclined to refer all anomalies to reversion.

The law of muscular evolution is specialization by the successive separation of new independent contractile bands from the large fundamental muscles, while the law of skeletal evolution is reduction of primitive parts and the specialization of articular surfaces. The number of muscles in the primates as a whole has, therefore, been steadily increasing, while the number of bones has been diminishing. In man the number of muscles is probably increasing in the regions of the lower arm and diminishing in every other region. The analysis is rendered very difficult by the fact that some muscles (*e. g.*, those connecting the shoulder with the neck and back) revert to a former condition of greater specialization when they were employed in swinging the body by the arms, and in quadru-

[1]Darwin: Descent of Man, p. 42.

pedal locomotion ; while other muscles (*e.g.*, those connecting the forearm and fingers) revert to a former simpler arrangement when the hand was mainly a grasping organ, and the thumb was not opposable.

As in the skeleton, we find that muscular anomalies include, 1, palæogenetic reversions, or complete restorations of lost muscles; 2, neogenetic reversions, or revivals of former types in the relations of existing muscles; 3, progressive variations, which either by degeneration or specialization point to future types; 4, fortuitous variations, which cannot be referred to either of the above.

Duval observes that the flexor longus pollicis repeats in reversion all the stages of its evolution between man and the apes, in which it is a division of the flexor profundus. Gruber and others have even observed the absence of the thumb tendon. This is true of all the new muscles. Of this Testut writes: "Ne dirait-on pas, en le voyant s'éloigner si souvent de son état normal, que la nature voudrait le ramener à sa disposition primitive, luttant ainsi sans cesse contre l'adaptation, et ne lui abandonnant qu' à regret l'une de ses plus belles conquêtes."

Speaking of the hand, Baker[1] says: "On comparing the human hand with that of the anthropoids, it may be seen that this efficiency is produced in two ways—first, increasing the mobility and variety of action of the thumb and fingers; second, reducing the muscles used mainly to assist prolonged grasp, they being no longer necessary to an organ for delicate work requiring constant readjustment." You have noticed the recent discovery that the grasping power of infants is so great that the reflex contraction of the fingers upon a slender cross bar sustains their weight; this power and the decided inward rotation of the sole of the foot and mobility of the toes are persistent adaptations. Our grasping muscle, the palmaris longus, is highly variable and often absent; like the plantaris of the calf, it has been replaced by other muscles, and its insertion has been withdrawn from the metapodium to the palmar fascia. In negroes we frequently find the palmaris

[1]Op. cit., p. 299.

reverting to its former function of flexing the fingers by insertion in the metacarpals.

The rise of muscular specialization by degeneration is beautifully shown in the extensor indicis, which, while normally supplying the index only, reverts by sending its former slips to the thumb, middle, and even to the ring finger. Testut[1] believes that the extension power of the middle and ring fingers has declined, as the cases of reversion point to greater mobility; the extensor minimi digiti is distinct and highly variable (Wood), often sending a slip to the ring finger.

The entire flexor group of the hand, excepting the palmaris, is apparently specializing. The demonstration by Windle[2] and Bland Sutton, that the origin of the flexors and entensors is shifting downward from their original position, is evidence of an adaptation to the short special contractions required of them.

The abductor pollicis[3] is also progressive and variable (Wood); the reduplication of its inferior tendon, which is sometimes provided with a distinct muscle, apparently points to the birth of a second abductor. The opponens of the thumb is well established and constant. Variability seems to characterize both the developing and degenerating muscles; the latter are apt to be absent; it is rare that an important muscle, such as the extensor indicis, is absent, but such cases are reported.

It is interesting to note that the lost muscles of the body are almost exclusively in the trunk or shoulder, and pelvic arches, and not in the limbs. It will be remembered that the human shoulder-joint is exceptionally rigid, whereas in the quadrupedal state it was a factor in progression. Some of the muscular reversions in this quadrupedal region are the levator claviculæ (1 to 60, Macalister), trachelo-clavicularis, scalenus intermedius, acromio-basilaris (Champneys), transversus nuchæ (Gegenbaur). Apparently associated with the former swinging of the body by the fore-limb in the arboreal life are the

[1]Op. cit., p. 564.
[2]Journal of Anatomy and Physiology, 1890, p. 72.
[3]Or extensor ossis metacarpi pollicis. See Testut, p. 553.

atavistic coraco-brachialis-brevis (Testut), the epitrochleo-dorsalis (Testut), and pectoralis tertius (Testut).[1]

Centers of Variability.—As the literature is so readily accessible I will not multiply illustrations of the innumerable congenital variations related to human evolution. I call attention to several important inductions. First, there are several centers in which both the skeletal and muscular systems are highly variable. Second, that the most conspicuous variations, and therefore the most frequently recorded, are reversions. Third, that structure lags far behind function in evolution.

The conclusions of Wood and Testut[2] are that variability is independent of age or sex, of general muscularity, and of abnormal mental development. Wood found 981 anomalies in 102 subjects; of these, 623 were developed upon both sides of the body, while 358 were unilateral. Of still greater interest are the statistics collected by Wood between 1867–68 in the dissecting-room of King's College, upon 36 subjects (18 of each sex). These show that there are more anomalies in the limbs than in the trunk; that anomalies are rare in the pelvis; that there were 292 anomalies in the anterior limbs to 119 in the posterior; that in both limbs the anomalies increase toward the distal segments, culminating in the muscles of the thumb, where they rise to ninety per cent. (mainly flex. long. pollicis, and abd. long. pollicis). These facts seem to prove conclusively that while variation is universal it rises to a maximum in the centers where human evolution is most rapid; here are Herbert Spencer's conditions of unstable equilibrium. This has a direct bearing, as I shall show, upon our theory of heredity.

Fortuitous Congenital Variations.—I have thus far considered only those variations which apparently have a definite relation to the course of human evolution. There is an

[1]Quain describes seventy anomalous muscles (Anat., Vol. I.) Testut describes a still larger number.

[2]Op. cit., p. 760.

entirely different class of congenital variations which may be described as fortuitous or indefinite because they do not occur in any fixed percentage of cases; they are liable to take any direction; they cannot be considered reversional because they are not found in the hypothetical atavus, and there is not sufficient evidence to cause us to consider them as incipient features of our future structure.

Some may not be truly congenital (*i.e.*, springing direct from the germ-cells) but may be merely deviations from the normal course of development. I may instance the variations in the carpus recorded by Turner[1] in which the trapezium and scaphoid unite, or the trapezoid and semi-lunar divide, or the astragalus and navicular unite (Anderson).

The best examples of fortuitous congenital variations are seen in supernumerary fingers and vertebræ. The eighth cervical vertebra, bearing a rudimentary rib,[2] is not a reversion because the most remote ancestors of man have but seven cervicals. In cases where a rib is developed upon the seventh cervical, however, the reversion theory is perhaps applicable because rib bearing cervicals are relatively less remote. The same distinction applies to polydactylism. How absurd it is to consider a sixth finger atavistic, when we remember that even our Permain ancestors had but five fingers.

We cannot, however, class as purely fortuitous a variation which occurs in a definite percentage of cases presenting twenty-four different varieties, but occurring in the same region. Such is the much-discussed[3] musculus sternalis, a muscle extending vertically over the origin of the pectoralis from the region of the sterno-mastoid to that of the obliquus externus. Testut lightly applies his universal reversion theory, and as this muscle is not found in any mammal considers it a regression to the reptilian presternal (Ophidia)! Turner also considered it as reversional in connection with the panniculus carnosus, the old twitching muscle of the skin, which plays so many freaks of reversion in the scalp and neck; this

[1]Journal of Anatomy and Physiology, 1884, p. 245.
[2]Arb. Lane: Journal of Anatomy and Physiology, 1885, p. 266.
[3]See Turner, Shepherd, and Cunningham: Journal of Anatomy and Physiology.

view is negatived by the fact that this muscle is innervated by the anterior thoracic (Cunningham, Shepherd) which would connect it with the pectoral system, or by the intercostal nerves (Bardeleben). Although the high percentage of recurrence in the sternalis in anencephalous monsters (ninety per cent. according to Shepherd) supports the reversion view, it is offset by the high percentage (four per cent.) in normal subjects, for this is far too high for a structure of such age as the reptilian presternal. Cunningham has advanced another hypothesis, first suggested by the frequency of this anomaly in women, that this is a new inspiratory muscle, having its origin in reversion, but serving a useful purpose when it recurs, and therefore likely to be perpetuated.

These fortuitous variations, as well as variations in the proportions of organs, play an important part in the present discussion upon heredity, for it is believed by the Weismann school that such variations, if they chance to be useful, will be accumulated by selection and thus become race characters.

The Limits of Reversion.—There is such a wide difference of opinion upon the subject of reversions that it is important to determine what are some of the tests of genuine reversions? How shall we distinguish them from indefinite variations or from anomalies like the sternalis muscle, which strain the reversion theory to the breaking-point?

Testut,[1] Duval, and Blanchard take the extreme position that almost all anomalies reproduce earlier normal structures, and that the exceptions may be attributed to the incompleteness of our knowledge of comparative anatomy. I may here observe that popular as the descent theory has recently become in France, neither these anthropologists nor the palæontologists show a very clear conception of the phyletic or branching elements in evolution. If they do not find a muscle in the primates they look for it in other orders of mammals. Now, since these other branches diverged from that which gave rise to man at a most remote period, the dis-

[1]Op. cit., p. 4.

covery of a similar muscle may be merely a coincidence; it is by no means a proof of reversion.

The first test of reversion is therefore the anatomy of the atavus, and this is derived partly from the palæontological record of the primates, partly from the law of divergence, viz., that features which are common to all the living primates were probably also found in the stem form which gave rise to man; finally, from the comparative anatomy of the living anthropoidea.

The second test is whether a structure passes the limits of reversion as determined by cases of atavism in which there can be no reasonable doubt. Two of these phenomena have recently been discussed, which seem to extend the possibilities of reversion back to structures which were lost at a very remote period. I refer to papers by Williams and Howes. Williams[1] has analyzed 166 recorded cases of polymastism; he finds that supernumerary nipples of some form occur in two per cent., and that in all except four of the cases examined the anomalies, tested by position, etc., support the reversion hypothesis. In the living lemurs, which form a persistent primitive group of monkeys, we find that the transition from polymastism to bimastism is now in progress by the degeneration of the abdominal and inguinal nipples, it is fair to assume that the higher monkeys also lost their abdominal nipples at a primitive stage of development, and therefore that cases of multiple nipples indicate reversion to a lower Eocene condition! Howes[2] has recently completed a most interesting study of the "intranarial epiglottis," or cases in which the epiglottis is carried up into the posterior nares, as in young marsupials and some cetacea, to subserve direct narial respiration. This has now been observed to occur by reversion in all orders of mammals, including the monkeys and lemurs. One case has also been reported by Sutton of its occurrence in a human fœtus. This is apparently a human reversion to a structure much older than the age of the lemurs.

The third test is the inverse ratio to time. It would seem, *a priori*, that the percentage of recurrence of atavistic structures

[1]Journal of Anatomy and Physiology, 1891, p. 224.

[2]Ibid, 1889, p. 587.

should decrease as the extent of time elapsing since the structure disappeared increases. This law is apparently established in the case of the condylar and intercondylar foramina, and if we examine all the percentages which have been established, we see at once that they bear a ratio to time; compare the relative frequency of the ischio-pubic (fifty per cent.), dorso-epitrochlearis (five per cent.), and levator-claviculæ (1.66 per cent.) muscles with the periods which have elapsed since their past service. This is why it is so important to establish percentages for all our atavistic organs; fuller statistics will not only bear upon heredity, but I can conceive of their application to the extremely difficult problem of estimating geological time. We must, of course, establish as a standard cases of congenital variation in which the frequency of recurrence has been steadily declining in the same race between two known periods of time—an available structure is the intercondylar foramen or supratrochlear foramen, as recorded by Blanchard, Shepherd and others.

The reversional tendency is hereditary. There are many cases, both of reversions (as in the teeth) and indefinite variations being hereditary, that is, reappearing in several generations, or skipping a generation and recurring in the second.

Summary.—There are clearly marked out several regions in the human body in which evolution is relatively most rapid, such as the lower portion of the chest, the upper cervicals, the shoulder girdle in its relation to the trunk, the lower portion of the arm and hand, the outer portion of the foot. We notice that these regions especially are centers of adaptation to new habits of life in which new organs and new relations of parts are being acquired and old organs abandoned.

We observe, also, that all parts of the body are not equally variable, but these centers of evolution are also the chief centers of variability. The variations here are not exclusively, but mainly, of one kind; they rise from the constant struggle between adaptation and the force of heredity. Here is a muscle like the extensor indicis attempting to give up an old function and establish a new one; it maintains its new func-

tion for several generations and then goes back without any warning to a function which it had thousands of years ago. Thus the force of reversion strikes us as a universal factor.

Now the singular fact about reversion is the frequent proof it affords of what Galton has called "particulate inheritance." When the extensor indicis reverts all the muscles around it may be normal; therefore we are obliged to consider each of these muscles as a structure by itself, with its own particular history and its own tendencies to develop or degenerate. Thus it is misleading to base our theory of evolution and heredity solely upon entire organs; in the hand and foot we have numerous cases of muscles in close contiguity, one steadily developing, the other steadily degenerating. Reversion very rarely acts upon many structures at once; when it does we have a case of diffused anomaly, some repetition in the epidermis or in the entire organism of a lower type. Yet in spite of reversion and the strong force of repetition in inheritance, the human race is steadily evolving into a new type. We must, it seems to me, admit that an active principle is constantly operating upon these particular structures, guiding them into new lines of adaptation, acting upon widely separate minor parts or causing two parts, side by side, to evolve in opposite directions, one toward degeneration the other toward development.

I may now recall the two opposed theories as to what this active principle is:

The first, and oldest, is that individual adaptation, or the tendencies established by use and disuse upon particular structures in the parent are, in some degree, transmitted to the offspring, and thus guide the main course of variation and adaptation.

The second is that all parts of the body are variable, and that wherever variations take a direction favorable (that is adaptive) to the survival of the parent they tend to be preserved; where they take the opposite direction they tend to be eliminated. Thus, in the long run, adaptive variations are accumulated and a new type is evolved.

Partial Table of Characters in Evolution.

Principal Regions of Evolution.	Developing Organs.	Degenerating Organs.				
		Retrogressive.	Variable.	Rudimentary (occasionally absent)	Reversional (from embryo).	Reversional (from germ-cells).
Skull and jaw.	Cranium.	Facial sutures.			Premaxillary.	
Spinal curvatures.		Infer. maxilla.				
		Hyoids.	Lumbars and pelvis.	Coracoid.		
Cervicals, lumbars, and coccyx.	Female pelvis.		Coccygeal vert.	4th and 5th caudals.	5th and 6th caudals.	Caudals +
Lower ribs.		8th rib.	12th rib.		13th rib.	7th cerv. ribs.
Scapula and lower humerus.	Scapula.					Condylar for.
	Clavicle.					S. trochlear. for.
Outer side of pes.	Hallux.	4th and 5th digits of pes.	Terminal phalanx of 5th dig of pes.			3d trochanter.
	Tibia.				Centrale-manus. Intermedium, pes.	
Teeth.....	.....	Canines.....	.....	.....	? Lateral incisor.	.....×.....
		Incisors, lateral sup.			? Third premolar.	4th premolar.
		3d molar.	3d molar.			
Flexors and extensors of arms.....	Flex. prof. and perf.	.....	.....	Paniculus carnosus.	.....×.....	Trans. nuchæ.[1]
	Extensor indicis.	Muscles of mastica'n				Epitrochl. dors.
	Flex. long. pollicis.					Acromio-basilar.
	Abd. long. pollicis.					Levator-claviculæ.
	Flex. long. hallucis.					Pect. tertius.
						Cor. brach. brev.
		Pyramidalis.				Ischio-pubic.
Shoulder to trunk.	Triceps extensor surae.	Psoas parvus.				Depressores caudæ.
Trunk to femur.						Scansorius.
	Glutæal group.	Abd. and add. hallucis.	Muscles, 5th toe.	Plantaris.		Abd. metars. 5th.
	Facial group.			Palmaris.		Peroneus parvus.

[1]It is probable that some of these muscles are represented in the fœtus.

It is evident at once, from a glance over the facts brought forward in this lecture, that the first theory is the simplest explanation of these facts; that use and disuse characterizes all the centers of evolution; that changes of structure are slowly following our changes of function or habit.

But while the first explanation is the simplest it by no means follows that it is the true one. In fact, it lands us in many difficulties, so that I shall reserve the *pros* and *cons* for my second lecture upon Heredity. The Lamarckian theory is a suspiciously simple explanation of such complex processes.

(*To be continued.*)

NOTE.—Since this lecture was written I have received copies of Topinard's "L' Homme dans la Nature," Paris, 1891, and of Wiedersheim's "Der Bau des Menschen als Zeugniss für seine Vergangenheit." The latter is full but not critical.

MENTAL EVOLUTION IN MAN AND THE LOWER ANIMALS.

By Alice Bodington.

The science of Psychology is at last emerging from the cloudland of Metaphysics in which it has been enveloped from immemorial ages. Deep would be the folly of the man who would declare that we know what mind or consciousness really *is*, but at least we are beginning to understand something of its phenomena on the physical side, and to recognize that even the human mind is a product of evolution. Whether an impassable gulf, or a rubicon which can be boldly and safely crossed, separates the human mind from mind in the lower animals, is still a moot point with men of the highest scientific repute.

I do not for a moment pretend to approach the question from the high metaphysical point of view, but only to apply to the subject the same method which has so successfully been applied in biology; to put theories on one side, until we have ascertained as many ordinary facts as possible. In biology the greatest triumphs have been obtained by the demonstration that ontogeny, the history of the individual, is a guide to phylogeny—the history of the race. And in examining the history of the race, we find the development of the lower species of animals an invaluable guide in understanding the development of the higher species. Moreover if we wish to understand the peculiarities of domesticated animals, we must study the habits of their wild relations. These three guides we may take in studying the development of the human mind; in the child we may study its ontogeny; in the development of intelligence in animals we can observe the dawn of faculties which attain their supreme expression in man; and in the more primitive or savage races of man, we may see the germ which contained the nucleus of our civilization.

In the child, we find at the beginning of life a mental condition as low as that of a blind puppy or a kitten, showing two instincts only,[1] of which one has but lately been revealed; and no glimmerings, for many months, of reason. From this humble beginning, to the highest point which human faculties can reach, there is no break; no point at which we can say "here mind exists, where yesterday it was not." Not only is the growth of the human mind gradual, but during its earlier phases of development it assuredly ascends "through a scale "of mental faculties parallel with those permanently presented "by the lower animals, whilst with regard to the emotions the "area these cover in the lower animals is nearly co-extensive "with that covered by the emotional faculties of man.[2]" The purely human *emotions* may indeed be limited to religion and the sense of the sublime.

And if from the history of the individual, we turn to all we know of the history of the race, the evidence of a gradual evolution of mental faculties is the same; from the rough flint weapons of the drift period, to the era of polished stone; from polished stone to bronze; from bronze to iron; from the fetich of shapeless wood stuck with feathers, and the merciless nature-gods, which men saw in sunshine and storm, in famine and in pestilence, to the Brahma of the Vedas and the God of Isaiah; from the rude sticks covered by skins of animals, and shelters of rough piled stones, to houses of wood and hewn stone, and thence to such conceptions as are embodied in the Parthenon, or in the Cathedrals of the middle ages we have similar evidences of evolution. And whatever point of view we take we see progress starting from the humblest beginnings; no matter how towering the building, its foundations are laid deep in the earth.

It has been alleged that this very progress in human affairs draws a shape line of demarcation between men and animals; that whereas in man a constant improvement goes on, no sign of progress can be found in brutes. This argument is weak

[1]The instinct, pointing surely to an arboreal ancestry, by which a new born infant will cling to a support unaided.

[2]Romanes: Mental Evolution of Man.

on both sides. On the one hand though constant, and even rapid improvement, is a characteristic of certain races of men, yet there are numerous races whose improvement is either stationary or incredibly slow. They are to other men, what the Lingula, which has remained unchanged since Cambrian times is to other invertebrates. There are savages still in the age of unpolished stone; savages whose religion is the lowest fetich worship; savages whose only refuge is a skin spread over a few sticks, and others to whom any kind of shelter is unknown. Some progress they have all made from the furry arboreal animal with pointed ears, but it has been a progress immeasurably behind that of the higher races of man. "Rapid and continuous improvement," in the words of Mr. Romanes, "is a characteristic of only a small division of "the human race, during the last few hours, as it were, of its existence." The wonder is that with articulate language, man should have improved so slowly.

On the other hand it would be impossible to deny the great improvement which has taken place in the mental and moral qualities of the dog, when we compare him with the wolves and jackals from which he is descended. He has won for himself a tribute of praise from some of our noblest poets; a tribute richly due to his devoted love and fidelity. Hear Wordsworth's lament:

> "Tears were shed.
> Both man and woman wept when thou wert dead;
> Not only for a thousand thoughts that were
> Old household words in which thou hadst thy share,
> But for some precious boons vouchsafed to thee,
> Found scarcely anywhere in like degree.
> For love that comes to all, the holy sense,
> Best gift of God, in thee was most intense;
> A chain of heart, a feeling of the mind,
> A tender sympathy which did thee bind,
> Not only to us men but to thy kind:
> Yea for thy fellow brutes in thee we saw,
> The soul of love."

And Byron writes not less warmly:

> "The poor dog, in life the firmest friend;
> The first to welcome, foremost to defend,

Whose honest heart is still his master's own,
Who labors, fights, lives, breathes for him alone,
Unhonored falls, unnoticed all his worth,
Denied in heaven *the soul he held on earth.*"

There can be little doubt that if other animals had been valued for their moral qualities, had these been carefully developed from generation to generation, they would have shown a like, or a greater improvement. The intellectual qualities shown by trained elephants, which in their youth have roamed wild through the forests, is so marvellous, that it is difficult to imagine or estimate what intelligence of the race might become after a few generations of cultivation. And the same remark applies to the acuteness of intellect shown in captivity by many apes and monkeys, which have been brought fresh from their native woods. What progress would creatures so intelligent, so teachable, so insatiably curious and so persevering make after a few generations of culture?

But putting aside the great development in the psychology of the dog, we have in paleontology the most unanswerable evidence of the vast improvement which has taken place in the *brains* of mammals since Eocene times.

In our own day the brains of the higher mammals show a great increase in the cerebrum, the part of the brain concerned especially with intellectual functions and its surface is greatly increased by convolutions. Gradually as we go back in geological time the cerebral hemispheres are smaller, then they no longer cover the mid-brain, and the latter shows distinctly, as in reptiles and fishes there are of course no convolutions, and finally in the Eocene we meet with mammals, immense in size, but with the brains of reptiles.[1]

A faulty nomenclature has probably had a great deal to answer for in the tardy recognition of the intellectual powers of the lower animals. Ideas have been divided into "simple" and "general," or into "concrete" and "abstract." It was impossible to deny the existence of simple ideas in brutes, but it was, and is, contended that they are incapable of abstract ideas. Mr. Romanes points out the existence of a wide territory between simple and abstract ideas, and he proposes a

[1]Origin of the Fittest. Cope.

threefold definition of ideas to which he gives several names. It will make the question clearer if we take three of these names and speak of simple, complex and abstract ideas; or of percepts, recepts and concepts.

This definition can be illustrated by taking the word "star." The recognition of one particular star is a simple idea or precept; the recognition of a number of stars, or of bright twinkling objects resembling the shining of stars, is a complex idea or recept. So far the mind of the higher brutes keeps pace with the developing mind of man. But the next step carries us beyond the mental powers both of infants and of animals: neither can conceive the idea of a star as present to the mind of an astronomer. This is an abstract idea or concept, and is unattainable except through the medium of articulate language. Where the child sees a twinkling spark, the astronomer is conscious of a flaming sun; where, until lately, men recognized the symbol of unchangeableness, the astronomer knows he beholds stupendous worlds rushing through space at unimaginable speed; where the Hebrew seer beheld "lesser lights" stuck in a solid firmament solely for the service of man, the astronomer knows that his eye beholds objects at a distance of millions upon millions of miles, objects whose grandeur throws our whole solar system into insignificance. An abstract idea is in itself capable of containing a volume of knowledge; its capacities have hardly any limits but that of the mind itself. Think only of the world of concepts contained in the words "political economy," "vertebrata," "liberty," "Aryan Race," "mythology," "ethics," and we see how far civilized man has outstripped, not only the lower animals, but the young of his own race and the savage; but *the break is not at the minds of the lower animals.* Rather there is no break, but a gradual evolution.

We may take as another instance of simple, complex and abstract ideas the idea of one particular dog in the mind of the child; the idea of dogs in general, extended to figures or pictures of dogs; and the ideas of the genus "Canis" as present to the mind of the zoologist. The first and second conceptions are common to the young child and the lower ani-

mals; the third transcends the power of either. The extension of simple ideas was amazingly illustrated by a little French child, who was warned not to touch fire and candles by the words "Ça brule." This idea she spontaneously applied to other shining objects. Her mother and nurse also amused her by hiding and saying "Coucou." Watching the sun set one evening the child generalized the ideas of shining, burning and of hiding, by exclaiming "Ça brule coucou." A terrier has a very simple idea as to a rabbit; to catch it and kill it anyhow and anywhere. But he also has a general idea of rabbits, as may be demonstrated by calling his attention to this idea if he is out for a walk, when a violent scampering, barking and digging for imaginary rabbits may be expected to take place. A dog formerly in the possession of the Archbishop of Canterbury had the habit of hunting pigs, and for inscrutable reason, always after prayers. After a time there were no more pigs to be hunted in the flesh, but at the word "pigs," the dog vehemently hunted imaginary pigs.

Finally it was enough to open the door, without uttering a word, and the dog rushed to his visionary pig hunt. A dog belonging to Mr. Romanes' sister showed that it not only had an idea of men and women, but that it could recognize that which was like a human being and yet was *not* one. This dog showed the utmost terror at the appearance of three life-sized pictures. But instead of attacking them with tail erect, as he would have attacked a strange person, he "barked violently and incessantly at some distance from the paintings, with tail down and body elongated, sometimes bolting under the chairs and sofas in the extremity of his fear, and continued barking from there." When the faces of the pictures were covered he became quiet and contented, but resumed his frightened barking if one was uncovered. Gradually he became accustomed to the pictures, and after a time he was taken away from the house for some months. On returning, he was again much startled at seeing the pictures, and rushed at them barking. Very quickly though he appears to have reasoned that he had seen these strange things—that were and were not—men and women, before, and that they had proved

harmless, for "after three or four barks he ran back to me "with the same apologetic manner he has when he has barked "at a well-known friend by mistake."[1]

If we arbitrarily confine the definition of "reason" to the power of putting our ideas into *words*, then of course animals must be denied the faculty of reason as they do not possess that of articulate speech. But if to "reason" be to form ideas in the mind; to class them together; to be influenced by them; to act upon them, then animals possess reason. And the extent of reasoning faculty depends upon the development of the brain; on its comparative richness in convolutions, and on its cultivation by education in animals as well as in men. The difference in degree is enormous, but differences in degree do not destroy homologies in zoological classification. An elephant's nose is still a nose though it is prodigiously elongated, and serves as a tactile and prehensile organ. It is not that man has one particular organ highly specialized; immense numbers of animals have organs highly specialized; the foot of the horse; the fore limbs of the bat; the whole skeleton of the whale are conspicuous instances. In man the specialization has been in the brain, and this has made him the master of creation, but the difference between the brain of man and of apes is not so great as the difference between the foot of the horse and that of the elephant. Yet the difference being not between foot and foot, but in the very organ of thought itself, the effect is incalculable in producing superiority of the one animal over the other.

It has been asserted that we can form no general ideas without words. It is true that we so commonly put our ideas into words, that we may be tempted to identify the one with the other. But deaf mutes who have been educated have related their mental experiences when untrained, and they describe themselves as "thinking in pictures." I have had a similar experience in meeting with two plants in the forest of British Columbia; one attaining almost to the dimensions of a forest tree; the other no larger than our wood anemone, yet agreeing exactly in the botanical peculiarity of their

[1]Romanes, Animal Intelligence, p. 456.

flowers. I know now that these plants belong to the genus Cornus, but I did not ascertain this fact for many months, and in the mean time I thought of these plants *in pictures* in which I was vividly conscious of their peculiarities. And where the mind is unable to avail itself of articulate language, this faculty of thinking in pictures may be carried to a point far beyond what we may imagine credible; just as the tying of knots in strings in a particular fashion served as whole books of history to the Peruvian Indians who were unacquainted with writing.

Moreover though unable themselves to employ articulate language, the higher animals have the mental advantage of being able to understand and remember spoken words.

It is estimated that the more intelligent elephants in government employ in India and Ceylon understand more than eighty words and phrases addressed to them by their keepers. This statement is the more credible when we consider the diversity of occupations in which trained elephants are engaged. The most striking instance I know of bearing on the reasoning powers of these sagacious animals is given in Mr. Romanes' work on Animal Intelligence,[1] on the authority of Mr. Bingley.

"In the last war in India a young elephant received a violent wound in its head, the pain of which rendered it so frantic and ungovernable that it was found impossible to persuade the animal to have the part dressed. Whenever any one approached, it ran off with fury, and would suffer no person to come within several yards of it. The man who had care of it at length hit upon a contrivance for securing it. *By a few words and signs* he gave the mother of the animal sufficient intelligence of what was wanted; the sensible creature immediately seized her young one with her trunk, and held it firmly down, though groaning with agony, while the surgeon completely dressed the wound; and she continued to perform this service until the animal was perfectly recovered." When we consider the passionate devotion of the female elephant to her young one, and the fury with

[1]Animal Intelligence. International Scientific Series, p. 399.

which she will defend it from injury or danger, it is almost impossible to admire too highly, the reasoning powers, the self-control, and the intelligent comprehension of words by this mother, under circumstances which would severely try all these qualities in a human parent. It is well-known that elephants patiently, and even gratefully endure painful operations performed on their own persons, such as the cutting open and dressing of deep ulcers, and the dropping of nitric acid in the eye. Yet the same animal would deeply resent the slightest intentional injury, such as the prick of a pin, and would lose no opportunity of revenge.

The account of the extraordinary intelligence shown by the trained elephant "Siribeddi" in the capture of wild elephants, is too long to be given here but will richly repay perusal. [Animal Intelligence, p. 402]. Her comprehension of everything required of her; her original ideas of what should be done on the spur of the moment; her intense enjoyment of the sport; her Delilah-like duplicity towards her male captives; her extreme care to avoid injuring the prisoners; all show an intelligence not below that of a human hunter, whilst in her care to avoid injuring her captives, she puts the human hunter to shame.

In the parrot, low as it is in the psychological scale, compared to the higher mammals, we have examples of the comprehension of words uttered by the animal itself. Mr. Darwin gives an instance of a parrot belonging to the father of Admiral Sir J. Sullivan, which invariably called certain persons of the household, as well as visitors, by their names. He said "good morning" to everyone at breakfast, and "good night" to each as they left the room at night, and never reversed their salutations. To his master he used to add to the "good morning" a short sentence, never repeated after his master's death. He scolded a parrot which had got out of its cage and was eating apples on the kitchen table, calling it "you naughty Polly." Similar instances of the proper application of spoken words could be indefinitely multiplied, but I will only quote the account given by Dr. Samuel Wilkes

F. R. S. of his own parrot, which he carefully observed.[1] He says that when alone this bird used to "utter a long catalogue of its sayings, more especially if it heard talking in the distance, as if wishing to join in the conversation, but at other times a particular word or phrase is only spoken when suggested by a person or object. Thus, certain friends who have addressed this bird frequently by some peculiar expression, or the whistling of an air, will always be welcomed by the same words or tune, and as regards myself, when I enter the house—for my foot-step is recognized—the bird will repeat one of my sayings. My coachman coming for orders has so often been told 'half-past two,' that no sooner does he come to the door than Poll exclaims 'half past two!' Having found her awake at night I have said 'go to sleep' and now if I approach the cage after dark the same words are repeated. Then as regards objects, *if certain words have been spoken in connection with them, these are ever after associated together.* for example, at dinner time the parrot, having been accustomed to have savory morsels given to her, I taught her to say 'give me a bit.' This she now constantly repeats, but only and appropriately at dinner time. The bird associates the expression with something to eat. Again being very fond of cheese, she easily picked up the word, and always asks for cheese at the end of the dinner course, and at no other time. She is also fond of nuts, and when these are on the table she utters a peculiar squeak: this she has not been taught, but it is Poll's own name for nuts for the sound is never heard until the fruit is in sight. Some noises which she utters have been obtained from the objects themselves, as that of a corkscrew at the sight of a bottle of wine, or the noise of water poured into a tumbler, on seeing a bottle of water. The passage of the servant down the hall to open the hall door, suggests a noise of moving hinges, followed by a loud whistle for a cab."

No animal hitherto under observation in England, has shown a more remarkable comprehension of spoken words than the Chimpanzee lately in the Zoological Gardens,

[1]Romanes, Mental Evolution in Man, p. 131.

London. This ape learned from her keeper so many words and phrases, that in this respect she resembled a child shortly before it begins to speak. Moreover it was not only particular words and phrases which she thus learnt to understand, but, to a large extent, "she understands the combination of these words and phrases into sentences, so that the keeper is able to explain to the animal what it is he expects her to do. For example she will push a straw through any particular mesh in the net-work of her cage which he indicates by such phrases as 'the one nearest your foot: now the one next the key-hole; now the one above the bar,' etc., etc. Of course there is no pointing to the places thus verbally designated, nor is any order observed in the designation. The animal understands what is meant by the words alone, and this even when a particular mesh is named by the keeper remarking to her the accident of its having a piece of straw already attached to it." This Chimpanzee could also count correctly as far as five. She was asked for two straws, five straws, one straw, etc., no order being observed in the requests. If she were asked for four straws she successively picked up three straws and put them in her mouth, then she picked up the fourth and handed over all the four together; the ape having been taught, if more than one straw were asked for, to hold the others in her mouth until the sum was completed.

The Crow is little behind the Chimpanzee in arithmetical genius if Monsieur Leroy Ranger at Versailles is to be trusted, and as his life-work consisted in watching the wild and tame animals of the royal domain, he was hardly likely to be deceived. He says "crows will not return to their nests dur- day-light, if they see anyone waiting to shoot them. If to lull suspicion a hut is made below the rookery, and a man conceals himself in it with a gun, he waits in vain if the bird has ever before been shot at in a similar manner. She knows that fire will issue from the cave into which she saw the man enter. To deceive these suspicious birds, the plan was hit upon of sending two men into the watch-house, one of whom passed on, whilst the other remained. But the crow counted and kept her distance. The next day three went,

and again she perceived that only two returned. In fine it was found necessary to send five or six men to the watch-house, in order to put her out of her calculations." The ape and the crow here contrast advantageously with savages who can only count up to one and two, and with the Dammaras who apparently can count only one. In buying sheep from a Dammara one must pay for each sheep separately, for if a stick of tobacco is the price agreed on for a sheep, it would sorely puzzle the simple savage to take two sheep and give him two sticks.[1] One stick must be paid for each sheep separately.

Of the intelligence of the special friend of man in the understanding of spoken words innumerable instances could be given, and many will, no doubt, recur to the mind of any person who has ever owned or watched a dog. Hogg the "Ettrick Shepherd" had a collie who understood most things his master said to him. On one occasion Hogg observed in the most natural tone possible. "I'm thinking the cow's in the potatoes." Immediately the dog, which had been lying half asleep on the floor, jumped up, ran into the potato field, round the house, and up the roof to take a survey; but finding no cow in the potatoes, lay down again. Some little time afterwards his master said in a tone of conviction: "I'm sure the cow's in the potatoes," when the same scene was repeated. But on trying it a third time, the dog only wagged its tail. I had a rough terrier named "Butts" which had, like most dogs, a horror of a bath. If the fatal words "Butts must be washed," or "Butts must have a bath" were uttered in his presence, he would like the "Snark" slowly and silently vanish away, and would be found—if found at all—cowering under the remotest of beds, trembling with apprehension.[2]

From the comprehension of spoken words, (with their imita-

[1]Galton. Tropical South Africa.

[2]I have lately had the privilege of making the acquaintance of a dog called "Peter," who undoubtedly understands spoken words, and not only special tones. Certain words uttered by complete strangers to Peter result in his performance of certain actions, such as "dying for his Queen, fetching slippers, shutting the door, walking and jumping through a hoop, etc., etc. The dog's whole face is quivering with intelligent excitement when he is spoken to.

tive use by parrots) we come to the question of the *origin* of language. Did it spring from the human mind, ready equipped for all uses, like Minerva from the brain of Jove? Or was its origin as simple and as humble, as evolution has shown the early beginnings of other things to be?

In studying the evidence for mental evolution supplied by language, it is essential to begin with the most primitive forms known to us. Instead therefore of having recourse to Sanskrit and kindred Aryan languages, the product of the mental processes of the highest race of man, we must examine the forms of speech of primitive people, and of semi-civilized and savage tribes. Here again ontogeny may take us further and deeper than phylogeny, and problems which have puzzled the learned may find their solution in the nursery.

The dawning wishes and desires of an infant are expressed by indeterminate movements of the legs and arms. A vigorous kicking of the legs will express the joy of a healthy baby at being taken from a place of which it is tired to a fresh room, or out-of-doors. Perhaps the first determinate movement that can be noticed is the forward movement of the arms with the hope of being taken by father, mother, or nurse, and the next, the stretching out of the hands for some coveted object, both occurring very early in a healthy baby. The frustration of these desires, as most of us know to our cost, is accompanied by most piercing vocal demonstrations indicating pain, anger, or disappointment. I cannot help regarding these vocal demonstrations as survivals from the mode of expressing himself "*Homo alalus.*" And if Miocene man roared and screamed as lustily in proportion to *his* size, as does our modern baby, the din must have been truly appalling, and calculated to strike terror into the heart of the Mastodon himself.

(*To be continued.*)

THE UNIONIDÆ OF SPOON RIVER, FULTON COUNTY, ILLINOIS.

By W. S. Strode, M. D.[1]

This report or review of the Unionidæ of Fulton County, Illinois, is based mainly on researches made on Spoon River, a tributary of the Illinois and at a point about twenty miles from its mouth. It is a sinuous, winding stream, something over 100 miles long and with a width varying from 100 to 150 feet. The valley through which it courses averages about one mile in width. In many places cultivated fields come up to the very banks of the stream, and then alternate with strips of timber, or a fringe four or five rods wide of willow, silver maple or elm, is left by the thrifty farmer to protect and hold the banks. Occasionally a great white-armed sycamore is still to be seen, a veritable giant left standing as a memento of the great forest that once filled all this beautiful valley.

The bed and banks of the stream present a variety of conditions suitable to the tastes and habits of a large number of the Unionidæ.

Deposits of black mud, or of mud and clay, sand-banks, and long stretches of rocky or pebbly bottom covered with a sufficient deposit of mud and sand to afford a burrowing place for the molluscs of the river.

The river is a clear-running spring-fed stream, with but little iron, lime or other corroding substances to damage or disfigure the shells; consequently they grow to a size and attain a beauty of markings and coloration not often excelled in the same species found in other water courses.

My observations have for the most part been confined to a part of the stream lying within four or five miles above and below the village of Bernadotte, and at such odd times and moments as a busy practitioner could spare from a large country practice. Provided with a bag or basket, and attired in gum boots reaching to the hips, a hurried run would be

[1]Bernadotte, Ill.

made to the beds of mussels a half mile or more above or below the mill-dam and in an hour's time a bushel or two of specimens would be taken, the collection perhaps representing fifteen to twenty species.

Unio rectus Lamarck.

Not abundant, and fine young shells not often found; both the white and purple nacre specimens are found. Shells seven to seven and a half inches in length are met with.

U. gibbosus Barnes.

Adult shells are common at a locality a mile below the village. Young uneroded specimens harder to obtain, nacre both liver colored and white and occasionally one is found with the shadings beautifully intermingled in the central parts, and with a marginal band of deep purple.

U. anodontoides Lea.

Common; found everywhere associated in small groups or singly. Not a hundred yards of bank can anywhere be found, where there is not more or less of the younger shells, which have been carried out by the muskrats or minks and from which a meal has been obtained from their juicy contents.

It would be interesting to know why Lea gave this handsome species its peculiar name, for it is as unlike an Anodonta as it well could be. The large old specimens are a rich horn color, while younger shells are almost white, and some beautifully rayed with greenish lines. These three allied species maintain characteristics and markings entirely distinct from each other.

U. plicata LeSueur.

Very numerous; wagon loads of them are taken out every season by fishermen to bait trout lines; bushels of them are carried away, and after the epidermis is removed by ashes water, they are utilized in the cemeteries for grave decorations; they are also much used as an edging to flower beds, and walks. A score of years ago, rings made of this shell were in considerable demand and some village geniuses worked up quite a paying industry in their manufacture. A piece of the shell would be worked down by grinding, and the use of drills,

round files, etc., a bit of the sky-tinted edge would be worked into a set, and this would sometimes be further enriched by the addition of a silver moon and stars, making a very pretty and unique ornament that would readily bring the maker one or two dollars.

U. multiplicatus Lea.

This species seems to me to be identical with *U. undulatus* Barnes, and *U. heros* Say. It is not common in Spoon river, but grows to an extraordinary size. Specimens have been taken eight and a half inches long, and weighing several pounds. It is indeed a hero in size.

U. ligamentinus Lamarck.

A numerous species, and growing very large; nacre always a pearly white in this locality. Some shells received from Wisconsin show a pink-tinted nacre. From a shell of this Unio, I took a year ago, one of the finest pearls that I have ever seen, a perfect oval, as large as a small white bean.

U. occidens Lea.

Quite common, and the handsomest Unio in Illinois; no two are alike, there being as great a variety in their markings as there are shells. About one in ten is of the rare pink variety, as beautiful as any sea-shell. The occidens like the anodontoides is a great traveler, and I have tracked them for hundreds of feet in shallow water before coming up to them.

U. ventricosus Barnes.

This species is probably a synonym of the preceding, at any rate if they are two distinct species they shade so interminably into each other that I do not know where to draw the line separating them. The large *U. ventricosus* is probably the male of occidens.

U. capax Green.

Several specimens that I have sent out as occidens, have been pronounced by competent conchologists as the above species. But as yet I doubt the correctness of their diagnosis and do not believe the true capax is to be found in Spoon river.

U. luteolus Lamarck.

This almost universally distributed species, is not without its representation in the rivers of Illinois.

U. tuberculatus Barnes.

Very common and fine; growing to a length of six and a half to seven inches. A characteristic species, totally unlike any other Unio. Found in many parts of the United States, and in all waters and localities maintaining its distinct individuality. In northern waters, nacre white. In the far south a few specimens are found in which it is purple.

U. alatus Say.

Not numerous, but found sparingly all along the river. One was found two years ago, nine inches long.

U. lævissimus Lea.

Very plentiful and fine; a beautiful glossy epidermis and purple nacre.

U. gracilis Barnes.

Quite common in certain localities; grows quite large, but the older shells show much erosion and are apt to be indented or otherwise injured. This Unio and the two preceding it, are a family group, and present many characteristics in common.

U. verrucosus Barnes.

Not common, but a few fine large ones are found, always presenting the peculiar liver colored nacre of this species. The young ones I have not yet met with. Have received this shell from Iowa under the name of *U. graniferus* Lea.

U. pustulosus Lea.

One of the most numerous of all the unios found in Illinois. In Spoon river all sizes from the small young shells to the largest adults are easily found.

U. pustulotus Lea.

Not so common as the preceding but distinguished from it by the lesser number and larger size of the pustule.

U. lacrymosus Lea. Synonym *asperrimus* Lea.

Plentiful, and beautifully marked; does not grow so large in Spoon river, as in the rivers of Indiana; some shells

received from White river being fully twice as large as any found in Illinois.

U. fragosus Conrad.

Not common. It is closely allied to *U. lacrymosus* Lea.

U. metanever Rafinesque.

Not uncommon in some localities and a characteristic species.

U. cornutus Barnes.

A unique species. I know of no locality in Illinois where it can be found in abundance. After a season's searching on the "Spoon" I am not rewarded with over twelve or fifteen, but these present such a variety of coloring of from green to red, and so odd in character with their knob or horn-like projections that each find is welcomed as a prize.

U. ebeneus Lea.

A few found in the Spoon; more common in the Illinois near Pekin.

U. elegans Lea.

This fine shell does not belie its name; it is truly an elegant Unio; found associated with the next species to which it is related.

U. donaciformis Lea. Synonym *zigzag* Lea.

Far more common than the elegant. A very handsome pink variety is found in Spoon river.

U. trigonus Lea.

A very common mollusc found everywhere on the Spoon; easily distinguished by its velvety epidermis and the red meat of the animal.

U. obliquus Lamarck.

Rare.

U. orbiculatus Hild.

A few found. A doubtful species.

U. parvus Barnes.

Common above the dam in deep water.

U. ellipsis Lea.

Rare.

U. solidus Lea.

Rare.

U. subovatus Lea.

Not common.

U. wardii Lea.

Not common.

Margaritana complanata Barnes.

Quite common, and the largest Margaritana.

M. rugosa Barnes.

Common, large and fine; salmon colored nacre.

M. marginata Say.

A few found in the Spoon.

M. hildrethiana Lea.

Have found them only in one locality on the Spoon. A half mile below the village of Bernadotte where a great ledge of rocks, juts out over the river; here at low tide the muskrats carry them to the flat top of a rock; and in no other place have I been able to find them.

M. calceola Lea.

A few in the Spoon, more common in the Illinois.

M. confragosa Say.

Rare.

Anodonta grandis Say.

Truly a grand species; specimens six to seven inches long have been taken. More common above the dam in deep water.

A. decora Lea.

More common in the Spoon than the preceding, and much more fragile.

A. plana Lea.

A fine shell; groups with the preceding, but much less common.

A. edentula Say.

Many in Spoon river, quite variable in coloration.

A. imbecilis Say.

Common near the "Big Rocks" a half mile down the river. Not so large as specimens received from other localities, but epidermis a more brilliant green.

A. corpulenta Cooper.

A. suborbiculata Say.

Two characteristic and beautiful Anodons, found in a lake near the mouth of Spoon river. The *A. suborbiculata* Say, is a fine yellow, waxy looking shell, and does not seem to be in any way related to any other Anodon.

I also found in this lake a variety of *U. anodontoides* but half the size of those found in Spoon river, and differing from it somewhat in shape.

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General Notes.

GEOLOGY AND PALEONTOLOGY.

Fresh-Water Diatomaceous Deposit from Staked Plains, Texas.—Some nearly white earth, very light in weight, from Crosby County, Texas, and within the Staked Plains region was submitted by Prof. E. D. Cope to the first of the undersigned authors for examination.

In a contribution to the "Vertebrate Paleontology of Texas," page 123 of the Proceedings of the American Philosophical Society, Prof. Cope states that this material is from the Blanco Cañon beds as named by Mr. Cummins in the first annual report of the Geological Survey of Texas, 1890, page 190, and describes it as a "white siliceous friable chalk."

Under the microscope this earth is found to be constituted almost entirely of the siliceous skeletal remains of fresh-water diatoms, probably 90 per cent. of the body of the earth being made up of these minute single celled forms of plant life. The mass was disintegrated and the diatoms separated and cleaned by J. A. Shulze after which the forms were referred to C. Henry Kain for identification which he has done with much care and after consultation with various authorities, both by personal letter and through the medium of their publications.

He reports: "This is a fresh-water fossil deposit. The species contained in it may now be found living in Utah and in the Yellowstone Park. Many of the species are also common to fresh water streams everywhere."

The following number of species, twenty-seven in number, though not exhaustive, is nearly so.

Amphora ovalis Ehr.; *Amphora uncinatum* Ehr.[1]; *Achnanthes ventricosa* Ehr.; *Campylodiscus clypeus* Ehr.[2]; *Cymbella cistula* Hempr.;

[1]This is doubtless the form which Ehrenberg figures as *Cocconema uncinatum*—see Proc. Roy. Acad. Berlin, 1870, pl. 1 (II) fig. 9. It is however really an *Amphora.*

[2]In a preliminary list furnished by C. H. Kain, and published by Prof. E. D. Cope in the paper before referred to (see page 123) this form is noted as *C. bicostatus*, having been wrongly identified before the cleaning of the material rendered the markings plainly visible.

Cymbella lanceolatum Ehr.; *Denticula valida* Pediceno; *Epithemia gibba* (Ehr.), Kutz; *Epithemia gibba* var. *parallela* Grim; *Epithemia zebra* Ehr., Kutz; *Epithemia gibberula* (Ehr.), Kutz var. *producta* Grim; *Epithemia constricta* Breb; *Encyonema ventricosum* Kutz; *Gomphonema clavatum* Ehr.; *Fragillaria virescens* Ralfs.; *Navicula major* Kutz; *Navicula viridis* Kutz; *Navicula rostrata* Ehr. *forma minor; Navicula bohemica* Ehr.; *Navicula elliptica* var. *minutissum* Grim; *Navicula decurrens; Navicula varians* Greg.; *Navicula brebissonii* Kutz; *Navicula forma* Kutz; *Nitzschia brebissonia* Wsm.; *Nitzschia spectabilis* (Ehr.), Ralfs.; *Surrirella geroltii* var.—Lewis Woolman and C. Henry Kain.

In the paper previously referred to Prof. Cope notes the occurrence in this diatomaceous stratum of a "Mastodon of the angustidens type" and of a horse allied to the *Equus ocidentalis* of Leidy, and defines the latter as a new species to which he assigns the name *Equus simplicidens;* and indicates by a comparison of Equus and Mastodon fauna that the age of the Blanco Cañon beds is probably intermediate between that of the Equus beds and the Loup Fork beds or the equivalent of the pliocene proper.

In view of this determination of the age of these beds the close correspondence of all the specific forms of diatoms above listed becomes interesting as showing the wide geological range for the forms of these low organisms.

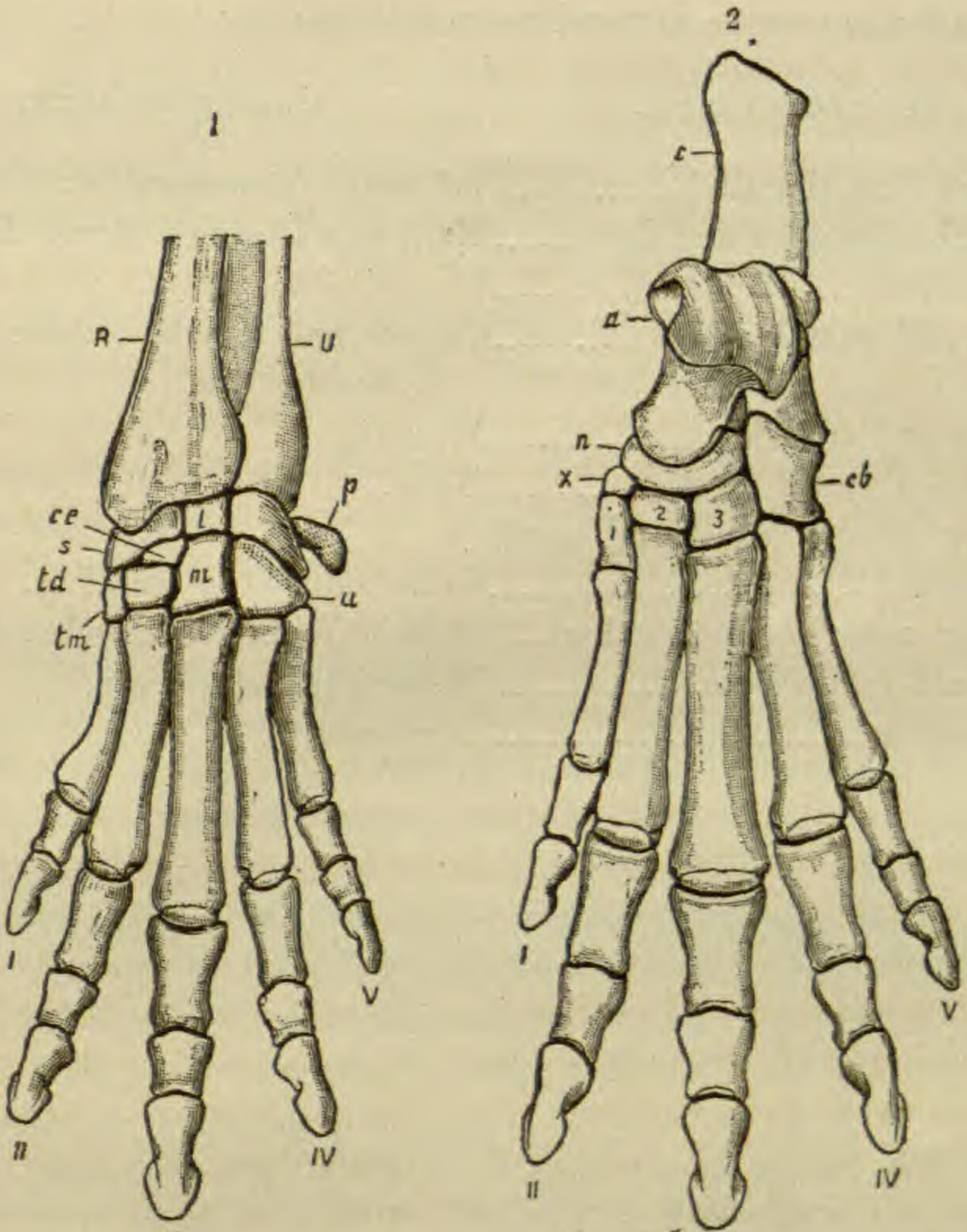
Is Meniscotherium a Member of the Chalicotheriodea?—The description of the complete foot structure of *Meniscotherium* or *Hyracops* by Marsh[1] tends to confirm the supposition I advanced in the Naturalist of October, 1891. At the time, I stated that the structure of the skull and teeth of *Meniscotherium* pointed to a striking similarity between this Wahsatch genus and the Miocene *Chalicotherium*, but that the question would turn upon the foot structure of the earlier form.

I reproduce here, side by side, for purposes of comparison, the fore and hind feet of *Meniscotherium* (Hyracops) *sociale* Marsh, and of *Chalicotherium*, from the figures of Gervais.

It will be seen at once that both are essentially tridactyl types. In *Meniscotherium* the three middle digits are greatly enlarged while the outer digits I and V are equally reduced in both the manus and pes, indicating that the feet are well established upon the tridactyl basis. Marsh describes the ungual phalanges, as intermediate between hoofs

[1]Am. Journ. Science, May, 1892, p. 447.

and claws. "Their extremities are thin, somewhat expanded, and more like those of primates than of any other group. They were apparently covered by thin nails." There is no displacement but the



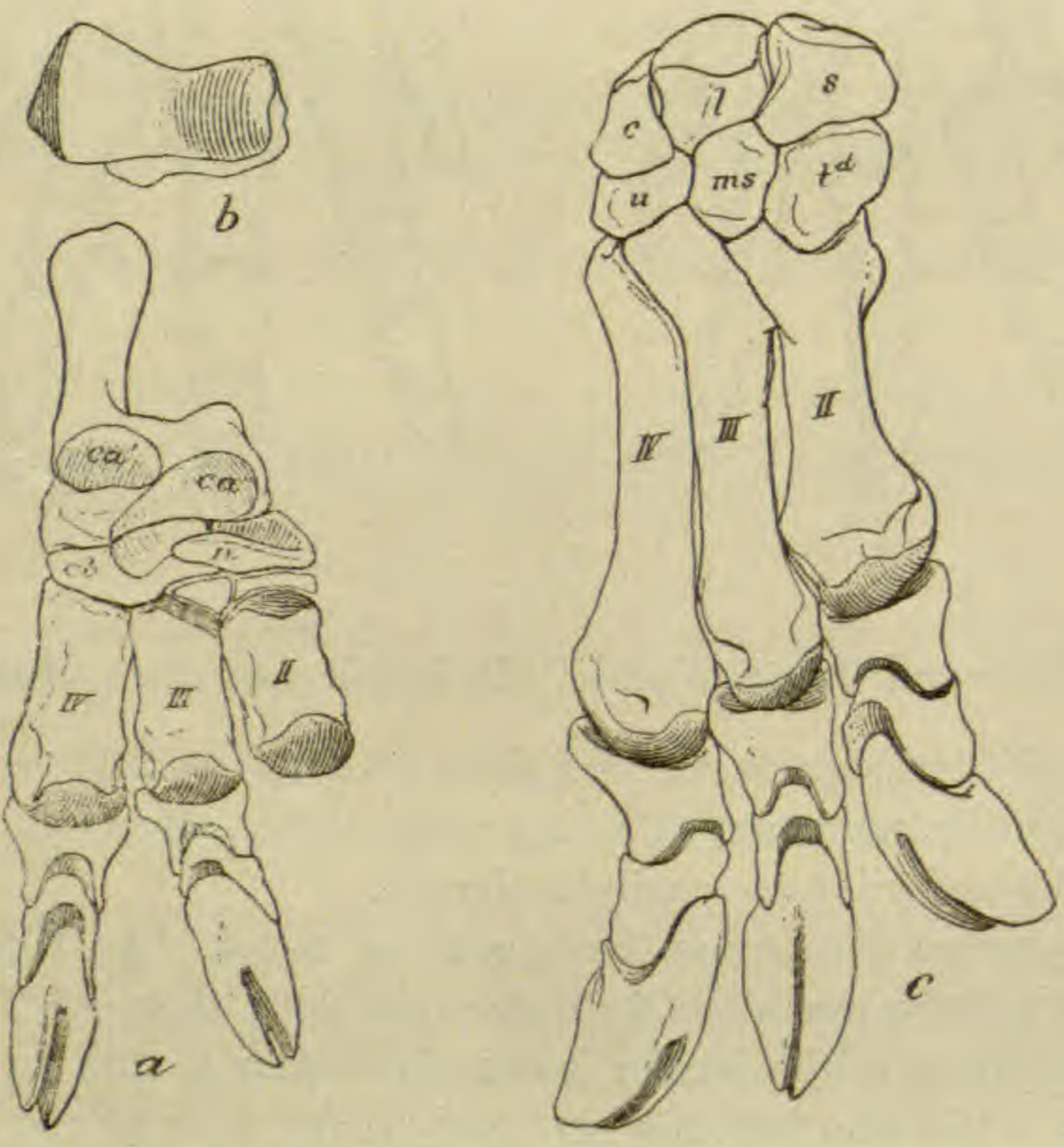
Fore and Hind Feet of Meniscotherium after Marsh.

carpals and tarsals are serial and there does not seem to be even any metapodial displacement. The inference is that *Meniscotherium* was, unlike *Chalicotherium*, a semi-plantigrade.

Many marked differences should also be noted. As I pointed out in comparing the limbs of *Chalicotherium* with those of *Palaeosyops*, the displacement in the former is exactly similar to that in the Perissodactyla. We also note the extremely short neck of the astragalus in *Chalicotherium* as contrasted with the long slender neck of *Meniscotherium*. There is also a great transformation in the claws. Most of

these differences may have been bridged over in the long period intervening between the Wahsatch and the Miocene. We find cases of a similar transformation in other lines both in the reduction of the lateral toes and in the displacement. The characters which unite and separate these forms may be summed up as follows:

Meniscotherium.	Chalicotherium.
Tridactyl (functionally).....	Tridactyl (structurally).
Main axis through third digit.....	Main axis through fourth digit.
Sub-ungulate.....	Unguiculate.
Carpals and tarsals serial.....	Carpals and tarsals displaced as in Perissodactyla.
Centrale and (tibiale).....	Wanting.
A fibulo-calcaneal facet.....	None.
Anterior portion of dental series reduced.....	Same reduced or wanting.
Superior molar buno-selenodont.....	Superior molars buno-selenodout.
Metaconid reduplicate.....	Metaconid reduplicate.
A mesostyle.....	A mesostyle.



Fore and Hind Feet of Chalicotherium after Gervais.

No third lobe on last lower molar...No third lobe on last lower molar.
Hypocone and metaconule united
in short transverse crest.....Hypocone and metaconule united
in a short transverse crest.

Altogether, the resemblances between these two forms are fundamental, the differences are mainly such as separate many lower Eocene from middle Miocene forms. Although no intermediate forms are known, there is a presumption in favor of a genetic relationship. At all events *Meniscotherium* will probably be removed from the Condylarthra, where it has always held an anomalous position and be placed in the Chalicotheriodea.—HENRY F. OSBORN, American Museum of Natural History. May 3rd, 1892.

Geological News.—General.—In a preliminary paper on the Ouachita Mountain System in Indian Territory, Mr. Robt. T. Hill remarks that these mountains should no longer be omitted from our maps, for they constitute the foundation of all later geologic structure in the Texas region, differentiating it from the Kansas-Missouri region in both present and past geologic times back to the earlier Mesozoic epochs, and influencing all the main river courses of Indian Territory whose great southward bends are an adaptation to the strike of this mountain system, the Washita alone having cut through it. (Am. Journ. Sci., Aug., 1891).——**Paleozoic.**—Mr. M. E. Wadsworth announces that the recent observation of the "South Trap Range" east of Lake Gogebic in Michigan shows that both the lava flows, and the eastern sandstone dip at a low angle, are one formation, and are as conformable as eruptions of lava can be with a contemporaneous sedimentary deposit. (Am. Journ. Sci., Nov., 1891).——**Cenozoic.**—A new species of Moa from New Zealand is announced by Mr. Lydekker, *Pachyornis rothchildi.* The species is founded on the right femur and the two tibio-tarsi and tarso-metatarsi figured and described in the Proceeds. London Zool. Soc., Nov., 1891.——The bird-bones collected by Major Forsyth from the Plistocene beds of Corsica and Sardinia have been referred by Mr. Lydekker to the following families: *Stringes, Acciptres, Picariæ, Passeres, Columbæ, Gallinæ,* and *Turbinares.* (Proceeds. Zool. Soc., London, 1891., p. 467).——Mr. R. D. Salisbury records a series of facts which warrant the conclusion that glaciation extended further southward than the hitherto accepted terminal moraine. The character of this extra-morainic drift indicates that it is probably the equivalent of the oldest glacial drift of the interior. (Bull. Geol. Soc., Am., 1892, p. 173).

MINERALOGY AND PETROGRAPHY.[1]

Quartz and Feldspar Inclusions in Diabase.—Backström[2] has discovered in several Scandinavian diabases inclusions of quartz and feldspar, and has carefully studied the effects produced by the reactions between them and the enclosing rock magma. The diabase consists of labradorite, three augites, magnetite and several secondary substances, and has a structure that differs slightly from the diabasic structure, in that the angles between the plagioclase and the more or less columnar augite, are filled with a groundmass of feldspar laths, pyroxene needles, magnetite and chlorite. Near the quartz inclusions the quantity of the groundmass increases and the diabasic structure becomes obscure, until it finally disappears, and in its place is seen a porphyritic aggregate with thick tabular crystals of plagioclase, well formed augite prisms and large grains of magnetite in a groundmass that occupies a third or a half of the field of view. Very near the quartz the plagioclase become smaller, and spherulites of quartz and feldspar more abundant, of which the latter mineral is either orthoclase or oligoclase. The feldspathic inclusions in the rock are orthoclase, microline and plagioclase. The action of the magma upon the microline is shown in the existence in it of 'solution-spaces,' which are spaces dissolved from the midst of the mineral and afterwards filled with rock magma, from which have crystallized pyrite, magnetite, ilmenite, needles of pyroxene, lath-shaped crystals of oligoclase, grains of quartz, calcite and masses of chlorite. The orthoclase inclusions sometimes become granulated, or filled with long lenticular areas of a feldspar whose origin is the same as that of the minerals in the solution spaces. Plagioclase fragments have also undergone granulation, and the new feldspar has crossed the original twinning planes irrespective of their directions. Other fragments are more completely penetrated by the magma, so that everywhere throughout their mass may be detected small areas of the diabasic groundmass with its spherulites. The peripheries of the grains are often marked by growths of new, colorless, transparent plagioclase, crystallographically continuous with the enclosed mineral. Mica, hornblende and other iron-bearing compounds seem less capable of resisting the action of the

[1]Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2]Bihang t. k. Svensk. Vet. Akad. Handl., B. 16, Afd. II, No. 1.

magma than the feldspar fragments. They are consequently often entirely dissolved, leaving behind them scarcely a trace of their former existence. When cores of these remain they are surrounded by magnetite, quartz (?) and sometimes newly formed biotite. Before closing his article the author calls attention to the differences in the action of diabasic and basaltic magmas upon enclosed fragments, the most noticeable being that in the former case no glass inclusions are developed in the material of the enclosed substances, while in the latter case these are abundantly formed.

The Basalts of Cassel.—Among the basaltic rocks occurring in the neighborhood of Cassel, Fromm[1] distinguishes limburgites, basalts and nepheline-basalts. All are porphyritic, with olivine, augite and labradorite (in the plagioclastic varieties) as phenocrysts in a groundmass of augite, plagioclase, probably sanidine, magnetite, ilmenite, hematite, mica and apatite in the feldspathic rocks and in the nepheline basalts with a groundmass of much the same character except that nepheline replaces the feldspar. Besides, a little glassy base is always present. Some of the olivine is brecciated as if broken by the movement of the rock in which it occurs. Again it is corroded, when it is often surrounded by a rim of glass, which the author thinks is due to rapid cooling of the dissolved portion of the mineral. The augites are often zonal, with the deeply colored zones within in the plagioclase basalts, and in the nepheline varieties with the lighter colored zones in the interior. The nepheline present in the nepheline basalts is either in the form of a uniformly distributed groundmass in which are imbedded microlites of augite or in little nests between the other minerals, or finally as small areas with crystal cross sections. Mellilite was detected in a nepheline basalt and good plates of pleochroic ilmenite were observed in several plagioclase basalts. Glass was present in the limburgite, in several plagioclase basalts and in one nephelinic variety. Quartz fragments included in the plagioclase basalts are surrounded by rims of augite crystals, between which and the nucleus is often a zone of glass. Sometimes the quartz has entirely disappeared, leaving only glass encircled by a crown of augite. Analyses of all the varieties of the rocks studied accompany the paper.

The Rocks of the Piedmont Plateau.—In an excellent article on the structure of the Piedmont Plateau in Maryland, G. H. Williams[2] divides the region between the Catoctin Mountains and the

[1]Zeits. d. d. Geol. Ges. xliii, p. 43.

[2]Bull. Geol. Soc. Amer., Vol. ii, p. 301.

Costal area into two parts, a Western one underlain by fragmental rocks in which but slight alteration has been effected, and an Eastern one characterized by both sedimentary and eruptive rocks that have been strongly metamorphosed by pressure. In the first area phyllites, including sericite, chlorite and ottrelite schists, sandstones made up of undoubtedly clastic grains, and a few crystalline limestones occur. In the Eastern area the piedmont rocks are gneisses, some of which are evidently eruptive and others probably sedimentary; quartzites and quartzite-schists, in which all evidences of fragmental origin have disappeared, coarse crystalline marbles containing phlogopite, tremolite, scapolite, etc., and acid and basic eruptives. Each of these classes, except those belonging to the eruptive division, is briefly characterized, and pictures[1] of the sandstone of the Western area and of the quartzite of the Eastern area are given for comparison.

The Diorite of the Andes, first mentioned by Stelzner as a characteristic rock of this mountain range, has been closely studied by Möricke[2] in the occurrence at St. Cristobal near Santiago in Chile. It is closely associated with andesites, both hornblendic and augitic, with propylite and tufas, in such a way that the author is led to look upon them all as facies of the same rock mass, the diorite representing the deep-seated phases and the andesites the surface flows. The hornblende, augite and hypersthene-augite, andesites and the diorites have the usual characteristics of these rocks. With respect to structure an intermediate phase occurs in the propylite, which consists of phenocrysts of plagioclase and green hornblende in a ground mass of plagioclase, chlorite and epidote. The propylite is much altered, while the other rocks are fresh. The geological relations of the different rock types correspond with the conclusions outlined as above. The 'stocks' of diorite, often forming the peaks of the range, are the denuded cones of old massifs.

The Porphyry of Monte Doja.—Pelikan[3] has re-examined the rock discovered by Suess at Monte Doja, in the Adamello group of mountains, and described by him as a reddish brown porphyry. The structure is porphyritic and the groundmass is dark brownish red in color. Under the microscope the thin section shows a colorless base containing yellowish-brown wisps of biotite, thin prisms and fine

[1]C. R. Keyes, Ib. p. 321.
[2]Min. u. Petrog. Mitth. xii, p. 143.
[3]Min. u. Petrog. Mitth., xii, p. 156.

needles of rutile and six-sided prisms of tourmaline. The colorless mass in which these are imbedded contains plagioclase, orthoclase and quartz. The porphyritic crystals in this groundmass are cordierite. They all possess a more or less hexagonal cross section, and the usual optical properties of the mineral. Its inclusions are biotite plates and rutile, and tourmaline crystals like those of the groundmass. The composition of the rock is represented by the figures:

SiO_2	TiO_2	Fe_2O_3	Al_2O_3	FeO	CaO	MgO	K_2O	Na_2O	H_2O
56.88		2.66	20.86	4.54	1.29	3.15	7.48	.90	2.36

Corresponding to 18% of cordierite, 20% of mica, 30% of orthoclase and 13% of plagioclase. The origin of the rock is unknown.

Wernerite Rocks occurring at several places in the Pyrenees are stated by Lacroix[1] to be altered feldspathic eruptives. The original form of the varieties from Sallix and Ponzac was a hornblende diabase containing olivine, biotite and sphene. The borders of the feldspar, which is labradorite, are often fringed by little plates of dipyr. Veinlets of these penetrate the plagioclase until in some cases all the labradorite is replaced by large plates of the scapolite, many of which are of much larger size than the feldspars from which they were formed. They moreover possess a uniform orientation over large areas, so that the structure of the rock passes from the microlitic to the granular. When dynamic agencies have modified it broken pieces of the scapolite are often found. This indicates to the author that in these cases the alteration of the feldspar preceded the crushing. On the other hand, broken pieces of all the other minerals are sometimes found cemented by unbroken dipyr, in which case the formation of the latter mineral was subsequent to the shattering. The alteration is thus a strictly chemical process. The paper closes with a reference to the Norwegian scapolite rocks and their comparison wth those of the Pyrenees.

Petrographical News.—The phonolites[2] of Montusclat and of Lardeyrols in the Ardennes, in France, contain small crystals and crystallites of låvenite, the latter often grouped into forms resembling the skeletons of large crystals. The larger crystals are golden yellow, with a strong pleochroism.

[1]Bull. Soc. Franc., d. Min. xiv, p. 16.
[2]Lacroix. Ib., xiv, p. 15.

Anatase and brookite are described[1] as occurring in French rocks, the former in the mica porphyrites of Pranal, Puy-de-Dom, and the latter in the chloritized mica of the limestone of Ville-es-Martin, in the Loire-Inférieure, and in the mica of a mica porphyrite from Pouchon, in Cercie, and in the granite of Lacourt, Ariège.

The same author[2] announces the discovery of octahedra of cristobalite associated with tridymite in a piece of quartz inclusion from the basalt of Mayen in Rhenish Prussia..

Nova Scotian Gmelinite.—A careful analysis of *gmelinite* from the Five Islands, Nova Scotia, has been made by Pirsson,[3] and the properties of the mineral have been investigated. The mineral occurs in seams in a decomposed trap. In thin sections its crystals are found to be composed of a colorless compact outer zone enclosing a flesh-colored, friable inner nucleus. Their habit is short pyramidal, and their axial ratio $a : c = 1 : .7345$. Two methods of twinning were observed, viz., interpenetration twinning with oP the twinning plane, and contact twinning parallel to $\frac{3}{2}$R. The double refraction is weak and negative, with $\omega - \varepsilon$ for sodium light = .0033. Density = 2.037, and composition :

SiO_2	Al_2O_3	Fe_2O_3	CaO	K_2O	Na_2O	H_2O
50.35	18.33	.26	1.01	.15	9.76	20.23

The author regards the mineral as a sodium-chabazite, in which Na : Ca = 8 : 1. The sodium is thought to exert a marked morphotropic action, since the crystallographic planes of the gmelinite cannot be conveniently referred to the axes of chabazite. It may, therefore, be considered as a distinct mineral species.

Crystallography of Cerussite, etc.—Pirsson[4] also contributes a few crystallographic notes on *cerussite*, *gypsum* and *krämmerite*. Twinned crystals of the first-named mineral from the Red Cloud Mine, Ariz., are arrow-shaped, with the plane $\infty \breve{P}3$ the twinning plane. The gypsums are from Girgenti, Sicily. They are twinned according to the usual law, but $\frac{1}{3}\bar{P}\infty$ so largely predominates over other forms that they resemble basal planes and cause the twinned crystals to resemble in symmetry an orthorhombic form. The krämmerite studied is from

[1]Lacroix. Ib., xiv p. 191.
[2]Ib., xiv, p. 185.
[3]Amer. Jour. Sci., July, 1891, p. 56.
[4]Amer. Jour. Sci., Nov., 1891, xlii, p. 405.

Texas, Pa., and is the same as that examined by Cooke[1] in 1867. Three new forms were observed on it, viz.: ∞P2, ½P2 and ⅓P. The prism ½P2 is very characteristic and is seldom wanting. The author also corrects the axial ratio for *mordenite* to $a : b : c = .401 : 1 : .4279$. $\beta = 88° 29' 46''$, and briefly describes skeleton crystals of *hematite* from Durango, Mex., filled with cassiterite and pseudomorphs of the latter mineral after the former.

Mineralogical News.—Dr. Hoffman[2] mentions a quartzite from the North shore of St. Joseph Island, in Lake Huron, whose joint planes are coated with limonite containing numerous tiny spherules composed of a nucleus of silica, coated with a humus-like substance, which in turn is overlain by a layer of metallic iron. The spherules form 58.85% of the mixture. They have a density of 6.8612 and the following composition: Fe = 88.00; Mn = .51; Ni = .10; Co = .21; Cu = .09; S = .12; P = .96; C = ?; insol. res. = 9.76. The insoluble residue consisted of little concentric bodies with the composition: $SiO_2 = 93.95$; $Al_2O_3 = 1.13$; $Fe_2O_3 = 1.02$; CaO = .62; Mg = .31; Loss = 2.97.

Analyses of uraninite from two new localities are given in a recent paper by Hillebrand[3]. The first is that of a specimen obtained from Marietta, Greenville Co., S. C., and the other that of one from the Villeneuve Mine, Ottawa, Quebec. Neither of the two was pure.

	UO_3	UO_2	ThO_2	ZrO_2	CeO_2	(La. etc.)	Yt. etc.	CaO	PbO	H_2O
S. C.....		83.95	1.65	.20	.19	2.05	6.16	.41	3.58	und.
Que.....41.06		34.67	6.41	?	.40	1.11	2.57	.39	11.27	1.47

	N	SiO_2	Insol.	Fe_2O_3	X
S. C.....	undet		.20	tr.	tr.
Que.....	.86	.19	.13	.10	.09

Results of the analyses of the same mineral from Llano Co., Texas, and from Johann-georgenstadt, Sax., show the presence of nitrogen in each.

Williams[4] has discovered *anatase* crystals in a jointed slate from five miles South of Bremo Bluffs, Buckingham Co., Va. The crystals are small and are associated with pyrite and quartz, which cover the faces

[1]Ib., 1867, xliv, p. 201.
[2]Amer. Geol., viii, p. 105.
[3]Amer. Jour. Sci., Nov., 1891, p. 391.
[4]Ib., Nov., '91, p. 431.

of the joint cracks. P and oP are the only faces observed on the anatase.——Crystalline masses of *ilvaite* are reported by Hoffman[1] from a twenty-foot vein near the head of Barclay Sound, Vancouver Island, British Columbia. Its hardness is 5.5, density 3.85 and composition:

SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	H_2O
29.81	.16	18.89	32.50	2.22	13.82	.30	1.62

Celestite from Scharfenberg, near Meissen, Saxony, according to Stuber[2] occurs in druses of little blue crystals whose axial ratio is .7807 : 1 : 1.2834, and whose habit is determined by the planes $P\breve{\infty}$, oP and $\frac{1}{2}P\bar{\infty}$. Another druse is made up of brown or wine-yellow crystals whose habit differs from that of the blue crystals in that oP is small. Their axial ratio differs also, since $a : b : c = .7834 : 1 : 1.2962$.

Weed and Pirsson[3] describe orthorhombic crystals of *sulphur* from around the vents at the Highland Hot Springs and at Crater Hills in the Yellowstone National Park, and stalactitic and fibrous growths of orpiment and realgar in crevices of the rock surrounding vents in the Western part of the Morris Geyser Basin in the same territory.

Nesquehonite exists in the anthracite mine of Mure, Isère. Its analysis by Friedel[4] gives results that prove its identity with the nesquehonite of Genth and Penfield.

Syntheses.—While heating mica with soda and sodium sulphate in a tube the mixture became dry, leaving a residue in which the Messrs. Friedel[5] discovered little rhombohedra, with the composition of *nosean*. Upon heating mica, soda and sodium carbonate for two days at 500° the same experimenters obtained little hexagonal pyramids of a substance with the composition $3\,(2\,SiO_2, Al_2O_3, Na_2O) + Na_2\,CO_3 + 2H_2O$, which the authors regard as a calcareous rich cancrinite. If amorphous alumina be heated at 530° in a solution of soda in a closed tube the excess of the first material will separate[6] upon cooling as *corundum*. If heated at 400° *diaspore* is produced. When the soda contains a little aluminum and calcium carbonates, *calcite* crystals

[1]Ib., Nov., '91, p. 432.
[2]Zeits. f. Kryst., xix, 1891, p. 437.
[3]Ib., Nov., 1891, p. 401.
[4]Bull. Soc. Franc. d. Min., xiv, p. 60.
[5]Bull. Soc. Franc. d. Min., xiv, p. 69.
[6]G. Friedel. Ib., xiv, p. 7.

accompany the corundum. These experiments throw some light upon the production of corundum in metamorphosed limestones. Under similar conditions magnesia yields *brucite.* When calcium silicate is treated with sodium borate at high temperatures under pressure *datholite* crystals are formed, according to Wyrouboff.[1]

Miscellaneous.—A new contribution to the discussion of the cause of optical anomalies is from the pen of Karnojitzky[2], who ascribes the phenomena to polymerism. Paramorphic substances are thought to be polymeric, with the higher polymer more stable than the simpler one. The latter usually possesses a higher degree of symmetry than the former, and hence, when it forms first it gives a higher degree of symmetry to its crystals than is possessed by those of its paramorph—the more stable, more complicated compound. The author develops this idea in a very logical and clear manner, and instances many examples to indicate the probability of the correctness of his statements.

Retgers[3] proposes to test the isomorphism of different substances by forming of them mixed crystals, which, if the two substances used be isomorphous, will differ continuously in their physical properties. In the case of colored salts the test most easily applicable is that of color. If potassium chlorate and the corresponding permanganate be dissolved in water and a drop of each be placed in an object glass and allowed to come in contact, the crystals formed at the junction of the two drops will be intermediate in color between those formed at a distance from it. In the case of salts that are not isomorphous no gradation in color will be observed. In his article the author mentions the many compounds that he has discovered to be isomorphous.

Lemberg[4] suggests a modification of micro-chemical analysis by which minerals are detected rather than their constituent elements. For instance, instéad of distinguishing between hauyne and sodalite by studying their elements, the author would study the effect of the minerals themselves upon reagents, *e. g.* sodalite will precipitate silver chloride from a weak nitric acid solution of silver nitrate, whereas hauyne will not do so. Chabazite reacts rapidly with ammonium chloride and generates ammonia, while thomsonite, analcite and leucite

[1]Ib., xiv, p. 197.

[2]Zeits. f. Kryst, xix, p. 571.

[3]Zeits. Physik. Chem., viii, July, 1891, p. , and Jour. Chem. Soc., lx, p. 1151, Cf.; also Lehmanne Die Krystallanalyse, p. 57.

[4]Zeits. d. d. Geol. Gesele., xlii, 1891, p. 737.

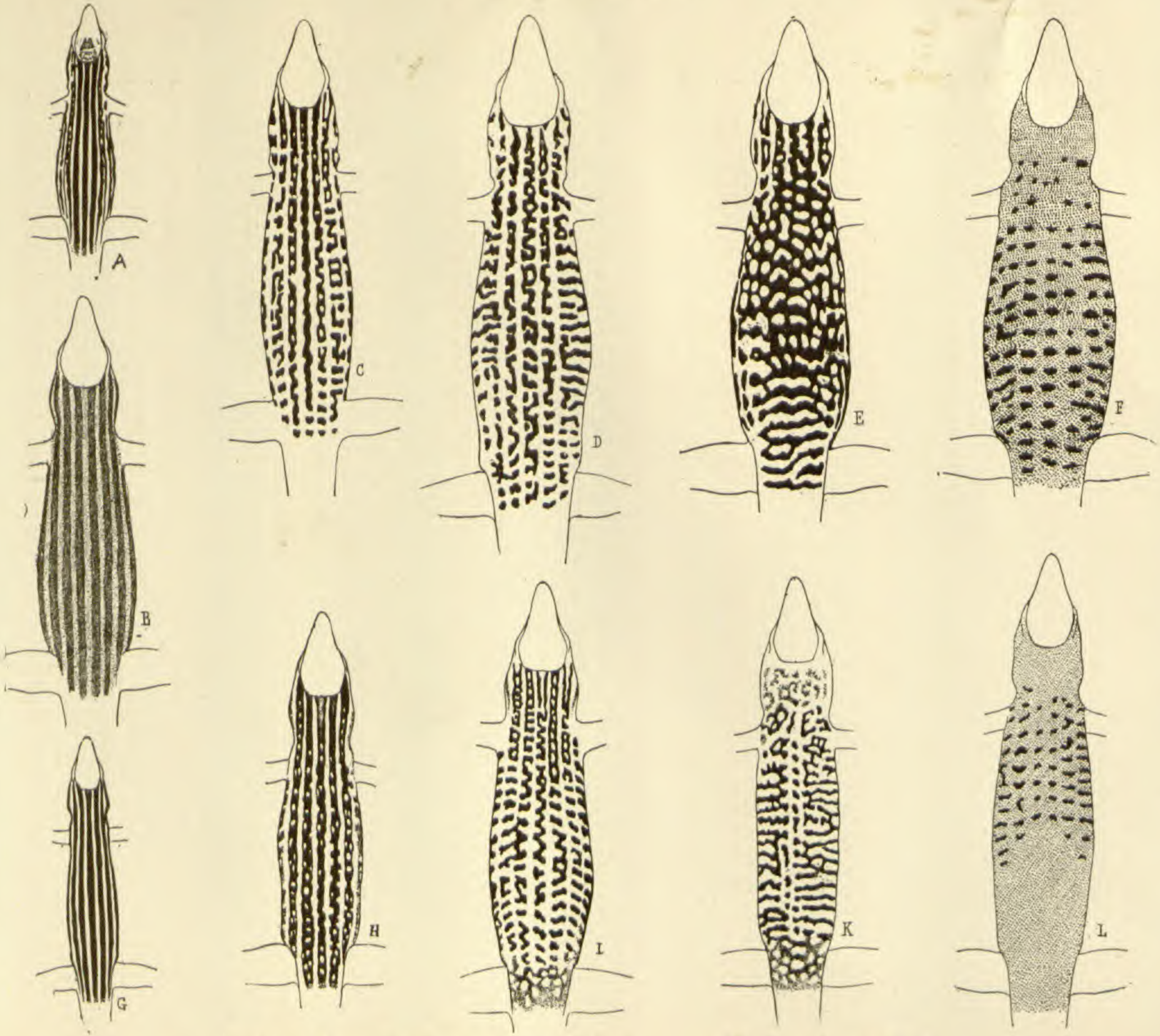
are without effect upon it of any kind. The principal minerals studied by the author that yield definite and distinctive results are hauyne, sodalite, scapolite, chabazite, calcite, witherite, cerussite and anglesite and others of less importance. The method of manipulation necessary to produce good results is described in each case with great minuteness.

Dufet[1] describes a method for the determination of the comparative values of the indices of refraction by means of the prism and total reflection, and Lavenir[2] gives an account of a new process by which the optical orientation of any crystal may be determined.

A report on "The Mineral Resources of the Province of Quebec," by Ells[3], contains a history of the various mining industries of the district. In the same annual report Hoffmann[4] publishes a list of the minerals occurring in Canada, and Ingalls[5] gives statistics relating to the production and exportation of the mineral products of Canada.

[1]Bull. Soc. Franc. d. Min., xiv, p. 130.
[2]Ib., xiv, p. 100.
[3]Pt. K. Ann. Rep. Can. Geol. Survey, 1888–89.
[4]Pt. I. Ib.
[5]Pt. S. Ib.

PLATE XVIII.



A–F, *Cnemidophorus tessellatus.* G–L, *C. gularis.*

ZOOLOGY.

The Classification of the Anthomedusan Jelly-Fishes.—Dr. Vanhöffen begins his attempt to arrange the Anthomedusæ[1] with severe criticism of the system of Haeckel and then gives that which he would propose to take its place, an outline of which follows here. The reader will notice the almost iconoclastic manner in which Dr. Vanhöffen relegates genera into synonymy.

ANTHOMEDUSÆ.

Craspedote Medusæ with the sexual products in the ectoderm of the stomach [proboscis].

I. CODONIDÆ. Gonads not separate; embracing the proboscis as a continuous ring.

1. Syncorynidæ (Sarsiadæ). Medusæ produced from Syncoryne and similar polyps, with regular radially developed umbrella, and four well-developed tentacles. Genera: 1, *Sarsia* (including *Codonium* and *Syndiction*), Hydroid, Syncoryne; 2, *Dipurena* (including *Bathycodon*), Hydroid?; 3, *Corynetis*, Hydroid, Halocharis?.

2. Pennariidæ, Medusæ with Pennaria-like hydroid; regularly developed umbrella and four rudimentary tentacles. Genus: *Glossiceps*.

3. Corymorphidæ, Medusæ with Corymorpha-like hydroid; umbrella either radial or more or less irregularly bilateral; tentacles four, two, one or none.—Genera: 1, *Amalthæa*, Hydroid, *Corymorpha*; 2, *Hybocodon* (incl. *Amphicodon*), Hydroid, Corymorpha; 3, *Euphysa* (including *Steenstrupia*), Hydroid?; 4, *Diconodum*, Hydroid?; 5, *Ectopleura*; Hydroid, *Ectopleura*.

II. OCEANIDÆ. Four or fewer pairs of interradial gonads in the ectoderm of the proboscis.

A. **Cœlomerintha.** Strongly contractile hollow tentacles whose small entoderm cells enclose a large lumen.

4. Amphinemidæ. With numerous marginal lobes like rudimentary tentacles between fewer well-developed tentacles.—Genus *Stomatoca* (including *Amphinema* and *Codonorchis*).

5. Tiaridæ. With numerous well-developed tentacles. Young with two (*Dinema*) or more tentacles between which are seen the soli-

[1] Zool. Anz. xiv. p. 439, 1891.

tary rudiments of other tentacles as thickenings of the umbrella margin.—Genera: 1, *Conis*; 2, *Tiara*, Hydroid, *Campaniclava*?; 3, *Turris*, Hydroid, *Clavula*; 4, *Catablema*.

B. Pycnomerinthia. Tentacles solid; filled with large entoderm cells.

a. MONERENEMATA. With simple separate tentacles.

6. DENDROCLAVIDÆ. With sessile nematophores on the margin of the mouth—Genus *Turritopsis*, Hydroid, *Dendroclava*.

7. PODOCORYNIDÆ. With short oral tubes and stalked nematophores on the mouth margin—Genera: 1, *Cytæis;* 2, *Thamnitis*; 3, *Cubogaster*; 4, *Dysmorphosa* (including *Cytæandra*), Hydroid, *Podocoryne*.

8. THAMNOSTOMIDÆ. Oral tube elongate, surpassing the stalked nettle clusters.—Genera, 1, *Thamnostylis*; 2, *Thamnostoma*; 3, *Limnorea*.

β. Lophonemata. Tentacles simple, in bunches.

9. BOUGAINVILLEIDÆ[1]. With stalked nematophores on oral margin.—Genera: 1, *Margelis*; 2, *Hippocrene* (including *Nemopsis*); 3, *Rathkea*.

γ. Cladonemata. With compound, feathered or branched tentacles.

10. PTERONEMIDÆ. Tentacles feathered.—Genera: *Pteronema; Ctenaria; Zanclea; Gemmaria*.

11. DENDRONEMIDÆ. With branched tentacles—Genera: 1, *Cladonema* (including *Dendronema*); 2, *Eleutheria*.

Free-Swimming Sporocysts.[2]—M. Braun has studied "free-swimming sporocysts" similar to those described by Prof. Wright,[3] only larger,—6 mm. long. They are shaped like a T and in the stem of the T a distorted Distomum was visible. Thus these apparently free-swimming sporocysts are enormously developed Cercariæ, closely allied to *C. macrocerca* and *cystophora*, except in furcocercal form. They apparently come from *Limnæus palustris* var. *corvus*. Feeding experiments were not successful in determining the final host.

Peripatus leuckartii Oviparous.[4]—Dr. Arthur Dendy thinks he has evidence to show that *Peripatus leuckartii*, unlike the rest of its congeners, lays eggs. He had one male and three females of the

[1] *Lizusa*, *Lizzia*, *Lizzella* and *Margellium* are included as young forms which can occasionally become sexually mature.

[2] Zool. Anz., xiv, 368, 1891.

[3] Am. Nat., xix, 310, 1885.

[4] Zool. Anz., xiv, 146, 1891.

species in a small vivarium, and on examination he found under a bit of rotten wood some twelve or fifteen eggs which closely resembled those taken from the oviducts of other females except that the chorion was exquisitely sculptured. This evidence is relative, not absolute, as will readily be seen.

North American Thysanures.[1]—Alex. Macgillivray catalogues the known species of North American Thysanura, enumerating 74 species. The list leads off with the three species of Scolopendrella.

Stridulation in Lepidoptera.—At the meeting of March 1, 1892, of the Zoological Society of London, Mr. G. F. Hampson read a paper on stridulation in certain Lepidoptera. The author attributed the clicking sound described by Darwin as produced by various species of the South American genus Angerona, and confirmed by Wallace and other observers, to the presence of a pair of strong corneous hooks with spatulate ends attached to the inner margin of the fore wings close to the base, and surrounded by a membranous sac which acts as a sounding board. An account was given of a similar sound produced by the males of a Burmese moth of the family Agaristidæ and of a buzzing sound in an allied Australian form, both of which have a patch of ribbed hyaline membrane below the costa of the fore wing. The sound was attributed to the friction of spines, attached, in the former to the first pair of legs, in the latter to the second pair, upon the ribbed membrane. A description was then given of the transformation of the costal half of the hind wing in the Noctuid genus Patula into a large scent gland, and of the manner in which this had distorted the neuration.—Zool. Anz., No. 387.

A New Compound Ascidian.—W. Garstang describes[2] under the name Archidistoma, a new genus of the Ascidian family Distomidæ which is of especial interest since "it exhibits the first stage in the evolution of the cœnobitic type of colony from the Social Ascidian type, in which the zooids are entirely free and irregularly placed; in *Archidistoma aggregatum* the clumps of zooids (primitive cœnobia) have no common cloaca, but the cloacas of the individuals are usually situated towards the center of the groups. The second stage is exhibited in such a compound Ascidian as *Synoicum turgens* or *Circinalium concrescens*, in which each of the isolated clumps of zooids possesses a common central cloaca."

[1]Can. Entomol., xxiii, 267, 1891.

[2]Zool. Anz., xiv, 422, 1891.

Lateral-Line Organs of Sharks.—Ewart and Mitchell, in two papers[1] describe the sensory canals in Læmargus and Raia. The lateral-line organs consist of two systems of canals and of minute sensory follicles. The so-called sensory canals open to the surface of the skin by numerous tubules, while the ampullar canals are enlarged at the proximal ends, and give off neither tubules nor branches. Previous authors have described the sensory canals according to position; Ewart and Mitchell think innervation should be the basis of grouping. The canals receive their nerve supply, 1, from the facialis or, 2, from the vagus, the latter innervating the lateral canal. Of the canals innervated by the facialis three main stems are recognized, the supraorbital, supplied by the ophthalmic; the infraorbital by the buccalis; and the hyomandibular by the corresponding divisions of the facialis. The further details have little interest in an abstract, except the great extension of the hyo-mandibularis canal over both surfaces of the pectoral fin of the skates. In this connection the editor may state that some as yet unpublished researches tend to show that these canals promise to throw considerable light upon the phylogeny of the fish-like vertebrates.

Parallel Color-Patterns in Lizards.—In The Naturalist for December, 1891, p. 1135, I called attention to the identical color-patterns displayed by the varieties of our two South-western species of Cnemidophorus, *C. tessellatus* and *C. gularis*, and the general similarity these species present to the *Lacerta muralis* of the Mediterranean countries, in color variations, which are pointed out by Prof. Eimer. Having recently published a paper on Cnemidophorus in the Transactions of the American Philosophical Society, I give two plates illustrating these facts. Plate xviii represents the two species of Cnemidophorus, A to F the *C. tessellatus*, and G to L the *C. gularis*. A is the color-pattern of the young and half-grown; B is *C. t. perplexus* B. and G., adult; C, *C. t. tessellatus* α; D *C. t. tessellatus* β; E *C. t. tessellatus* γ; F *C. t. rubidus* Cope; G *C. gularis* young and half grown; H do. adult; I and K, *C. g. sealous* Cope α and β; L *C. g. semifasciatus* Cope. Plate xix represents some of the variations of the *Lacerta muralis*. A represents the young coloration; B the var. *L. m. campestris*; C the *L. m. albiventris*; D *L. m. maculata*; E *L. m. tigris*.—E. D. Cope.

[1]Zool. Anz., xv, 116, 118, 1892.

A New Genus of Bats.[1]—Dr. Harrison Allen considers the *Histiotus maculatus* of Mr. J. A. Allen as the type of a new genus for which he proposes the name Euderma. It is a Plecotian genus without muzzle processes and with two premolars in the lower jaw.

Human Rumination.—It is well known that there are some persons who possess the power of regurgitating their food, causing it to pass from the stomach back to the mouth, and to do this voluntarily; this is the difference between rumination and involuntary regurgitation, or eructation. Heredity plays here, perhaps, an important role; the imitation is frequent, and men are more addicted to the habit than women. Rumination is a physiological phenomena, which can be of use in studying the digestive functions; it is also a pernicious habit, or, at least an unpleasant one. Many persons have contracted this habit because it gives them pleasure, because the food thus regurgitated has an agreeable flavor; one of them said that "it was sweeter than honey and more delicious." The point of departure toward this habit is often accidental; it is caused by the ingestion of some irritating and indigestible substance. A well known physiologist became a ruminant while endeavoring to obtain some gastric juice from his own stomach. He swallowed a sponge to which was attached a thread; the irritation of the foreign substance caused a regurgitation which persisted for some time. There are some who regularly practice rumination for the pleasure experienced; others, only after they have eaten hastily. In the latter case it is a hygienic measure. The regurgitated food has an agreeable flavor as long as the stomach is sound and well, otherwise it is disagreeable.

In order to be rid of this habit, which, to say the least is an unpleasant one, the food should be thoroughly masticated and all care should be taken to exclude irritating and indigestible substances. In extreme cases it is sometimes necessary to limit the patient to liquid foods for some time.—(Revue Scientifique, March, 1892.)

[1]Proc. Phila. Acad., 1891, 467.

EMBRYOLOGY.[1]

Growth of the Ovum in the Fowl.[2]—Prof. M. Holl, of Gratz, has made a detailed study of the formation of the membranes, acquisition of the yolk and change in the character of the nucleus of the hen's egg, while in the ovary.

In the chick just hatched the ova form "nests" or clusters of naked cells, each about 14 μ thick, beneath the germinal epithelium and surrounded by the connective tissue stroma of the ovary. Each ovum, when about 20 μ thick becomes enveloped by a delicate *tunica adventitia* that is really formed by some of the stroma cells flattening themselves out around the ovum; it is thus a product of the stroma, not of the ovum, though it is usually called the "vitelline" membrane.

Later the "follicular epithelium," so called, is formed around the ovum by the arrangement of spindle shaped stroma cells in a single layer about the ovum. The author would call this second stroma membrane the *granulosa*.

These epithelioid cells increase so that the follicle is made up of several layers. External to it a thin *membrana propria* is formed by a few flat stroma cells. Finally the stroma itself is arranged in a system of concentric fibres and cells, external to the three membranes it has formed. The ovum and its fellow epithelial cells are thus excluded from any part in the formation of the egg membranes.

The large central nucleus of the ovum is at first central, but makes two successive migrations towards the surface of the cell, becoming flattened on one side and applying this side close against the *tunica adventitia*, when it takes up its permanent position in the ripe egg. Irregularities in its contour are regarded, not as pseudopodia, but as artificial products. The nuclear net-work of chromatin has at first a fine mesh, but undergoes complex changes leading to its breaking up into minute granules, which are distributed throughout the nuclear substance.

The body of the ovum at first presents a wide-meshed system of non-staining material: this is then replaced by a fine-meshed system of staining material radiating out from staining centers, the *dotterkern*, next the nucleus. This mesh-work becomes finer and finer and its

[1]This department is edited by Dr. E. A. Andrews, Johns Hopkins University.

[2]Prof. M. Holl: Sitzb. Akad. Wiss. Wien, 1890, pp. 311–369, pl. I.

interstices occupied by very minute granules, which are the starting point for the formation of the yolk spherules.

These yolk spherules form first near the nucleus and then towards the periphery of the egg. In this way is formed what appears to be the white yolk at the center of the ripe egg.

The remaining mass of yolk is made gradually by the conversion of successive layers of granules into yolk spherules. These layers are formed outside the central mass and close to the *tunica adventitia*, the last formed being the outermost. Some of these layers become converted into yellow yolk.

The peripheral granular layer of the egg grows and is nourished by the aid of the *zona radiata*. This peculiar layer is formed, now, between the *tunica adventitia* and the granular outermost part of the egg and remains as long as yolk formation continues. Though apparently a part of the ovum, this layer is, the author holds, in reality a system of parallel radiating fibrils which are merely processes of the follicle cells! These processes pass through holes in the *tunica adventitia* and at the other end become continuous with the mesh-work of the peripheral part of the ovum.

The follicle (stroma) cells and the ovum are thus united by intercellular processes, by which nutrient liquids may pass into the ovum.

When the egg finally escapes from the ovary some fibrillar remnants of this *zona radiata* remain adherent to the inner side of the *tunica adventitia* and thus cause the somewhat double nature of the "vitelline" membrane.

No observations were made upon the proper maturation of the ovum, though certain peculiar bodies in the nucleus are regarded as preparations for the formation of the polar cells.

Sexual Glands in Mammals and in the Fowl.[1]—Dr. J. Janosik, from sections of embryos of the fowl, the sheep, the hog and man, has arrived at the following interesting conception of the nature of the genital glands, in reference to sex.

A proliferation of cells of the germinal epithelium gives rise to strings of cells which are to be later developed in the male (testis) but which in the female (ovary) are not developed. A second proliferation of the epithelium gives rise to the nests of cells to form the ova of the ovary.

The gland, ovary or testis, thus has a central, older, part that may become the male portion, and a peripheral, younger part that may

[1]Janosik: Sitzb. Akad. Wiss. Wien, 1890, pp. 260–288, pl. I.

become the female portion. If both derivatives of the germinal epithelium were to develop, both the first central, and the second, peripheral, there would result an hermaphrodite gland.

The epithelial cells that form the sperms in the male would be thus somewhat older, ontogenetically, than the epithelial cells that form the ova in the female.

The Tail in the Human Embryo.—Dr. Franz Keibel[1] having sectioned and reconstructed several human embryos of different ages endeavors to decide the difficult question as to the value of the posterior end of the trunk, as to the existence and magnitude of what may be truly called the tail.

In spite of the various criteria used by His in determining what is to be regarded as the caudal region, such secondary changes as the movements of the pelvis made known by Rosenberg make the problem much more difficult than might at first appear. The author counting back from the head reckons those mesoblastic somites or vertebræ as caudal which would be posterior to the sacrum of the adult.

From the present material and the observations of His and Fol it seems that embryos of 4 to 6 mm. have a true projecting tail with chorda, mesoblastic somites, medullary tube and also a caudal intestines or post-anal gut. Later the number of caudal segments may be as many as six while the intestinal tube closes first at the base then towards the tip of the tail.

This caudal appendage is thus more perfectly developed in the embryo than in the adult: a fact which the author would add to the various facts of human and comparative anatomy, which he enumerates as evidence of the former existence of a complete tail in the ancestors of man.

Embryonic Veins in the Limbs of Amniota.—Dr. F. Hochstetter[2] finds in the limbs of the rabbit, chick and the lizard a remarkable similarity in the earliest condition of the venous supply. Moreover the anterior and the posterior limbs are at first identical in this respect.

In such an embryonic limb, before the digits are apparent, there is an axial vessel serving as an artery and sending blood by radiating branches towards the single vein, which borders the pad-like foot. This border vein continues up the limb, on both anterior and posterior

[1]Archiv. f. Anat. Phys., 1891, pp. 356–388, plates 19–20.

[2]Morph. Jahrbuch, 17, 1891, pp. 1–42, plates 1–3.

sides, to connect with certain vessels in the trunk. Thus each limb contains a venous loop forming a border along the free tip of the limb, the foot.

As the digits form, the border vein becomes interrupted, but radial vessels remain between the digits. Various changes take place in the limbs of the venous loop, one limb soon disappearing so that but one of the original two connections between foot and trunk remains.

Later changes become too complex to be easily expressed in small compass and may be here passed over. Most of the work was done upon living specimens, so that the direction of blood-flow and certain interesting changes from artery to vein function could be observed.

In the Anamnia the author found in a Triton that though there is no border vein yet there is a vascular loop for each limb and later, when the digits appear successively, there is a duplication of this loop for each digit, producing a resulting arrangement not utterly different from the later stages of the border vein in the Amniota.

Endothelium and Blood Corpuscles in the Amphibia.[1]—Dr. Shwink has made a detailed study of the formation of the endothelial lining of the heart and chief vessels and of the origin of the blood corpuscles in the Anura *Bufo vulgaris* and *Rana fusca* as well as in the urodeles *Triton alpestris* and *Salamandra atra.* In these amphibians the author finds evidence that the cells forming the blood vessels arise, in part at least, in the entoblast and not in the mesoblast. Though he cannot exclude the mesoblast entirely, yet he fails to find evidence that it has any part to play in forming the endothelium, and regards the yolk-entoblast as forming most, if not all, of the endothelium cells.

The blood corpuscles arise later than the endothelial cells. They are made in three blood-islands posterior to the heart into which they are then carried by the movement of the serum. The nuclei of the corpuscles do not come from yolk spherules but from pre-existing nuclei which divide actively in the first formed corpuscles.

In the Anura the blood corpuscles are not formed from the mesoblast but from the yolk-entoblast. Yet this may be a recent departure from a phylogenetically older formation of blood cells from some mesoblast that is now incorporated in the entoblast. In the urodeles the evidence is conflicting and at present the author is unable to to decide whether the blood-islands are of mesoblastic or of entoblastic origin or in part of both.

[1]Morph. Jahrb., 7, 1891, pp. 288–331, plates 17–19.

ENTOMOLOGY.

Notes on Harvest-spiders.—In my previous papers upon the Phalangiidæ I have used the genus Oligolophus of C. Koch adopting the characters given by Semon, in his Arachnides de France, who, in a footnote (v. VII, p. 238), says: "Le genre Oligolophus a été créé par le Dr. C. Koch de Francfort pour le *P. terricola* et ses congénères, et caractérisé par l'absence de fausses articulations aux metatarses de la première paire de pattes, tandis que dans son genre Opilio les fausses articulations sont bien visibles. Ce caractère est pour moi de peu de valeur; aussi, tout en adaptant le genre Oligolophus, lui donne je une composition et une caractéristique differentes de celles de son auteur. En effet, les fausses articulations sont tres-variables dans une meme èspece, et elles manquent aux metatarses de la premiere paire chez les *alpinus* et *morio* que le Dr. C. Koch laisse dans le genre Opilio, tandis quèlles sont faiblement rudiqueés chez le *glacialis*, qui en est si voisin. Je joins aux Oligolophus les quelques especes pour lesquelles M. le Dr. T. Thorell a formé le genre Mitopus."

This was published in 1879, the genus having been first erected in 1872. In 1876 Dr. Thorell published his Mitopus. This distinguished arachnologist has kindly sent me a copy of the paper in which his characterization occurs, and in a recent letter says: "I see you have (with M. Semon) adopted the name Oligolophus instead of Mitopus Thor. The genus Oligolophus was founded by a Dr. Carl or Karl Koch of Wiesbaden (later of Frankfort a.M.) for those forms of the genus Opilio C. L. Koch in which the metatarsi are without "articulationes spurio." But this is a character of so little importance that even in the same specimen you may find that one side of the body belongs to the genus Opilio of K. Koch while the other side belongs to his Oligolophus. As also in my Mitopus the metatarsi may want the "'articulationes spurio.' Mitopus is founded on quite another, and as I believe, a good and constant character—the presence of a strong tooth on the under side of the first article of the mandibles.'"

In view of these facts I now give preference to Mitopus rather than Oligolophus. The characters of Mitopus according to Dr. Thorell are as follows: First joint of mandibles armed below with a strong, pointed tooth. Ocular tubercle not constricted, denticulate above, of nearly equal length and breadth. Claw of palpus not denticulate;

maxillary lobes of second pair of legs similar to Phalangium; the skin is not coriaceous.

Our species of this genus are *pictus* and *ohioensis.*

The two western species described by Dr. H. C. Wood as *Phalangium favosum* and *P. nigrum* which on account of their hard skin I have heretofore referred with some doubt to the sub-family Sclerosomatinæ prove not to belong there, as I learn from Dr. T. Thorell to whom I submitted specimens, and who writes that they represent undescribed genera. It seems to me that they differ sufficiently from the Phalangiinæ to form a distinct subfamily. For *P. favosum* I have erected the genus Trachyrhinus, which is characterized as follows:

Body very hard: dorsum a large plate with a rough, coarsely punctate surface. Front margin of cephalothorax furnished with two denticulated tubercles. Eye eminence prominent with two rows of large tubercles having spinose tips. Legs rather long, thickly beset with spinose tubercles. Pores on margin of cephalothorax rather small, oval. Palpal claw smooth; inner distal angle of femur very slightly, and of patella quite strongly developed. First joint of mandible furnished with a tooth on lower surface.

One species *Trachyrhinus favosus* (Wood) inhabiting the Western States.

The *P. nigrum* of Dr. Wood may serve as the type of the new genus Mesosoma, having the following characters:

Dorsum a firm hard plate thickly studded with small hemispherical tubercles. Eye eminence of nearly equal height, length and breadth, covered with similar tubercles, and not carinated. Palpi moderately robust not branched, and furnished with many tubercles; palpal claw pectinate. Tooth on underside of first joint of mandibles. Legs short, coriaceous, robust. Lateral pores on upper margin cephalothorax very distinct, subcircular.

One species, *Mesosoma nigrum,* found in the western and southwestern States. It is possible that the western form described by Wood may be different from Say's species. The latter records his species as common in Georgia and the Carolinas, but I think none have since been reported from this locality.

These two species belong neither to the Phalangiinæ nor the Sclerosomatinæ as now restricted by European authors, having some characters of each. They apparently form a new sub-family which may be called the Mesosomatinæ, and be defined as follows:

Body very hard, most of the dorsal segments being united in a firm dense plate. Posterior dorsal and the ventral segments having their

margins developed into thin overlapping plates, especially in the males, the ventral plates being sometimes obsolete in gravid females. Pores on margin of cephalothorax distinct. Anal piece unique. Maxillary lobe of palpi with two tubercles.—CLARENCE M. WEED.

The Cattle Tick.—The Journal of Com. Medicine and Veterinary Archives for July, 1891, and January, '92, contains two articles by Dr. Cooper Curtice upon this insect (*Boöphilus bovis*). The first contains an account of the life history; while the last presents the habits of the species. Dr. Curtice refers this species to the genus Boöphilus (ox loving), "in which the rostrum and palpi are very short; the capitulum wider than the combined width of the palpi and rostrum; the second and third segments of the palpi nearly equal and each widest about the middle where the sides project in an angle; eyes present." This species has been formerly referred to the genus Ixodes.

Dr. Curtice recommends kerosene emulsion for destroying the cattle ticks, especially when the cattle are shipped north, because of the supposed relation which the ticks bear to Texas fever. I wish here to call attention to a remedy for this pest, with a few additional facts as to the ticks being the means by which the germs of Texas Fever are disseminated.

In regard to remedy there is but one objection to kerosene emulsion and this is that in order to keep the cattle free from the ticks the emulsion would have to be applied almost daily. This is especially true where the cattle are pastured in herds where they may be supplied with a fresh lot of ticks every day. A far better remedy consists in feeding the cattle equal parts of sulphur and salt. This should not be given occasionally, but kept where the cattle may have free access to it at any time. That this remedy will keep the cattle free if only given occasionally is not claimed, nor is it true. But it *is* very effectual, however, if the sulphur and salt be kept where the cattle may have free access to it. It is probable that the sulphur acts as a repellent owing to the fact that it is very largely eliminated from the body through the skin. It is hence used in the treatment of many skin diseases. This matter of a proper remedy is of vast importance throughout the South where the cattle have some portions of the body constantly covered with the ticks throughout the summer and autumn months. The decrease of flesh and milk consequent from the attack of the ticks must be considerable.

That ticks are the means of disseminating the germs of Texas fever is a much disputed point. There seems to be some doubt, also, as to

the exact nature of the germs of Texas fever, some claiming it to be a small protozoan attacking the red corpuscles of the blood, while others claim that the true germ is an ovoid bacterium, between a micrococcus and a bacillus, not directly attacking the red corpuscles. That ticks *may* be *a* means of spreading the germs of Texas fever is quite probable. Last October Dr. Billings of Nebraska obtained pure cultures of an ovoid bacterium from ticks sent him from here. Several calves inoculated with the cultures were almost immediately taken with Texas fever. This would seem to show that the germs may exist in the ticks, but that they spread the germs to northern cattle or that they are the principal means of the dissemination of the germs are as yet open questions.—HOWARD EVARTS WEED, Mississippi Agricultural College.

Recent Bulletins.—That the experiment stations are doing important work in disseminating information concerning injurious insects, as well as in original investigations of them, is shown by the numerous bulletins upon the subject. In New Mexico, Prof. Townsend issues as Bulletin No. 5, of his station, a discussion of certain fruit insects attracting attention in that region. In Iowa, Prof. Osborn discusses "Lice affecting domestic animals," (Bulletin No. 16) and in Oregon, Prof. Washburn briefly describes (Bulletin No. 18) a large number of injurious species. A particularly attractive bulletin (No. 40) comes from the Kentucky Station. It is a discussion of "Some common pests of the farm and garden" by Prof. H. Garman. Like all of Prof. G.'s publications it is carefully prepared, and is well illustrated, several of the figures being new. It is a pity that more station bulletins cannot be gotten up in as good shape as regards proof-reading, typography and paper as this.

The subject of spraying has received attention in bulletins from the Pennsylvania, New Jersey, Michigan, Massachusetts, and other stations.

Notes and News.—At a recent meeting of the Cambridge Entomological Club the following officers were elected for the current year: President, Rev. W. J. Holland, Pittsburgh, Pa.; Secretary, Roland Hayward; Treasurer, Samuel Henshaw; Librarian, S. H. Scudder; Executive Committee, S. H. Scudder and J. H. Emerton.

In a recent *Journal of the Columbus Horticultural Society* (v. VI, No. 4) Mr. F. M. Webster has a readable paper on "Insect Parasites," with fifteen illustrations.

According to *Science* the entomological collection of the late Henry Edwards has gone into the possession of the American Museum of Natural History, New York City. Friends in theatrical circles subscribed $10,000 and the Museum $5,000 for its purchase. The collection includes more than 350,000 specimens.

From *Psyche* we learn that a study of California butterflies, and especially their comparison with those of Eastern America and Europe, leads S. H. Scudder, in the *Overland Monthly* for April to claim that the highest type of human civilization is to arise on the Pacific coast.

Prof. C. H. T. Townsend of the New Mexico Agricultural College is vigorously prosecuting his studies of American Tachinidæ, as is shown by numerous recent papers in entomological periodicals.

Prof. J. B. Smith has recently published as Bulletin No. 851 of the U. S. National Museum a Revision of the Species of Mamestra.

In an admirably illustrated paper Dr. C. V. Riley gives, in recent *Insect Life* (v. IV, Nos. 7 and 8) an interesting account of the larger digger wasp (*Sphecius speciosus*), concluding with this suggestive paragraph: "If man could do what these wasps have done from time immemorial, viz., preserve for an indefinite period the animals he feeds on by the simple insertion of some toxic fluid in the tissues, he would be able to revolutionize the present methods of shipping cattle and sheep, and to obviate much of the cruelty which now attends the transportation of live stock and much of the expense involved in cold storage."

MICROSCOPY.[1]

Notes on Bone Technique.—In preparing bone for sectioning it is well to have fresh material taken from a young individual. After the soft parts are removed the bone is cut into short pieces and then macerated in water until the medulla is easily washed out; they are then ready to section.

Preparations nearly as good as those obtained by maceration may be made from fresh tissue. Thin sections are cut from the desired region with a fine saw; from these the medulla should be carefully washed out under a jet of water; they are then ground until the desired thinness is reached, again washed, dried and mounted. The grinding may be done with a file or on a revolving grindstone or with emery on a dentist's lathe[2], or between pieces of compact pumice stone, followed

[1]Edited by C. O. Whitman, Clark University, Worcester, Mass.

[2]Nealey, Am. Mon. Micro. Jour., 1884.

by hones of finer grain, and finally polished on a piece of smooth leather or buckskin covered with powdered chalk.

Another method is to grind the bone on a glass plate with emery of different degrees of fineness. This may be accomplished by pressing the section down with the fingers, or it may be fastened to a cork by means of sealing-wax or thick balsam. It is then polished on one side until smooth; then the wax or balsam is melted, the section turned and polished on the other side until the required thinness is reached. Only compact tissue can be prepared by this method. The spongy tissue, being very delicate, must be imbedded before sectioning. This may be done according to the method given by Wiel,[1] Koch's copal method[2] or a mixture of ten parts resin and one of ordinary wax may be used.[3] The objects should be placed in a very fluid, but not too hot, solution of the above, and after a short time lifted out with forceps, leaving as much of the mixture as possible adhering to the object. When cool the mass may be cut into thin sections and ground in the ordinary way, washed and cleared in turpentine and mounted in balsam. If an opaque preparation be desired the imbedding mass is removed by washing in chloroform and the section dried between sheets of filter paper and mounted.

A very convenient method is given by Ranvier.[4] The fragment of bone is placed in a syrupy solution of gum arabic, and when saturated it is exposed to the air until the gum thickens; it is then hardened in alcohol. From this mass sections are made and ground in the usual way, except alcohol is used to wet the hone instead of water. When ground sufficiently thin the gum is dissolved in water and the section is ready to mount. According to the method of mounting either opaque or transparent preparations are made. For the study of Haversian canals, lacunæ and canaliculi the former is better. To obtain an opaque preparation a drop of balsam is placed on the slide and heated over a spirit lamp to evaporate the oil; it is then cooled and tested by a needle. If hard the balsam is again softened and the dry section placed in it; at the same time a drop of balsam is placed on the cover glass which is applied, and the whole transferred to a cold surface; this should be done as quickly as possible in order that the balsam may solidify before penetrating the cavities. If, on

[1]Zeit. f. wiss. Mikros., Bd. iv, p. 200, 1888. Abstract AM. NAT., xxiii, p. 520, 1889.

[2]Whitman's Embryological Methods, p. 233.

[3]Ehrenbaum, Zeit. f. wiss. Mikros., Bd. i, p. 14, 1884.

[4]Traite, p. 249.

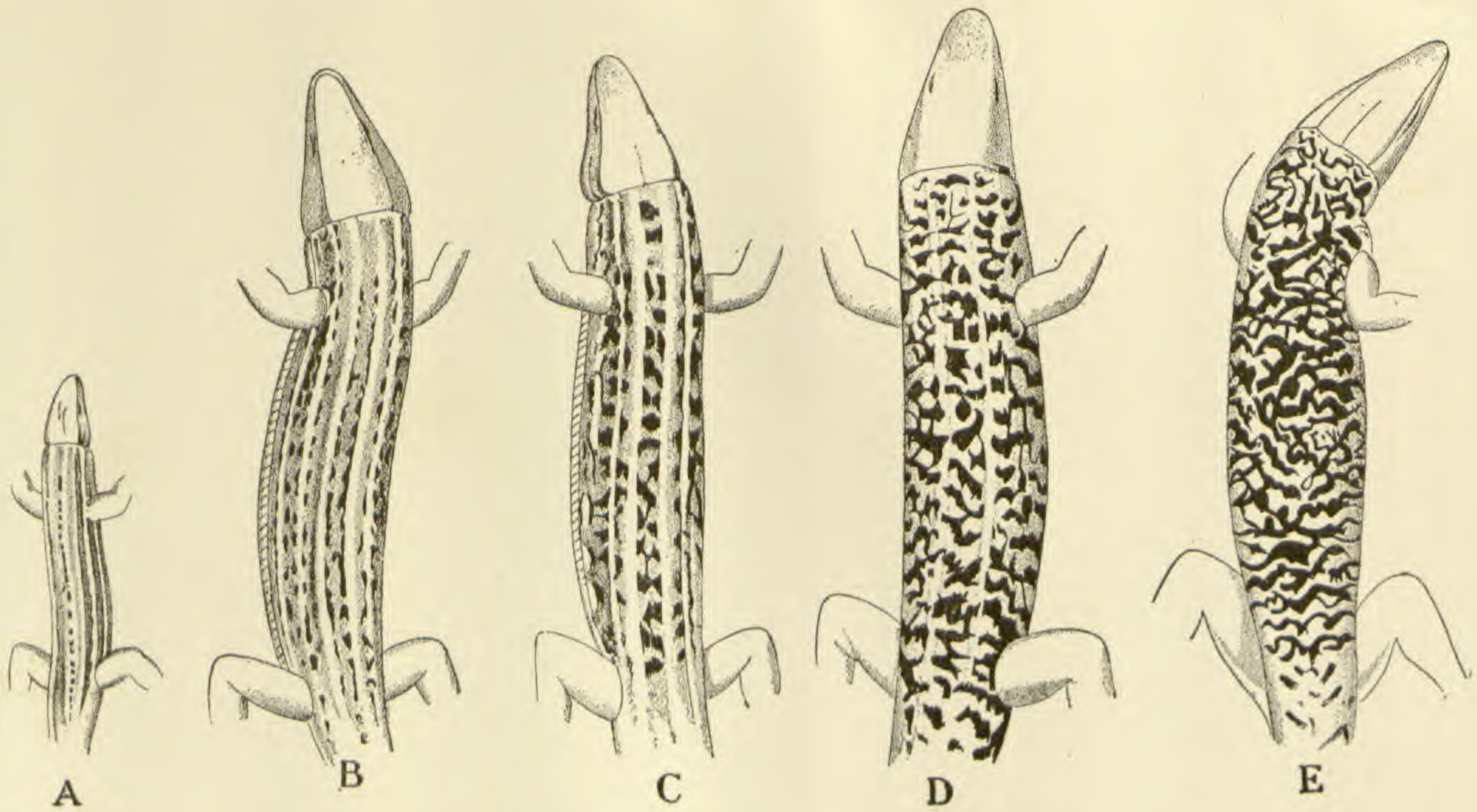
the other hand, we wish to study osseous lamellæ or stained preparations, the section is first placed in a solvent of balsam, then transferred to a warm solution of balsam until the entire canalicular system is filled, when it is mounted.

Methods of Decalcification.—*Thomas' Nitric Acid Method.*[1] —Pieces of fresh or hardened calcified tissue, bone, tooth, etc., are placed in 95% alcohol until completely saturated, then transferred to a solution consisting of five parts 95% alcohol and one part c.p. nitric acid, in which they are left for several days. The liquid should be occasionally shaken and renewed until the tissue is completely decalcified. The process is very rapid, owing to the solubility of the potassic nitrate in weak alcohol. Very large pieces may be decalcified in from two to three weeks. The object is then placed in a vessel of 95% alcohol, to which calcium carbonate is added until there is a residue of the precipitate. This mixture should also be occasionally shaken and renewed. After several days litmus paper no longer shows an acid reaction; the object is left in the fluid a day or two longer, then washed with a spray of alcohol, which removes the most of the calcium carbonate deposited on the surface. The extremely fine particles remaining do not in any way interfere with the cutting. If one wishes to avoid this deposition the object may be wrapped in filter paper. This, however, requires a longer time for the removal of the acid. By this method large pieces of very dense tissue are very rapidly decalcified and then completely freed from the acid; the soft parts undergo but little swelling, while the tissue stains as readily as before decalcification.

Haug's Phloroglucine Method.[2]—This is one of the most rapid decalcifying agents; the structures are perfectly preserved with the exception of blood, which is considerably changed. The introduction of the method is due to Andeer,[3] who used the phloroglucine in combination with hydrochloric acid, but with variable results. By substituting nitric acid perfectly uniform results are obtained. The solution is prepared by warming 1 g. phloroglucine in 10 c.c. of c.p. nitric acid. This must be done slowly and carefully; soon a dark ruby solution is obtained; to this is added 50 c.c. distilled water. If a larger quantity of the fluid is desired 10 c.c. acid are added to every 50 c.c. of water until the volume has reached 300 c.c., which is the limit of the protective

[1]Zeit. f. wiss. Mikros., Bd. viii, p. 191, 1891.
[2]Zeit. f. wiss. Mikros., Bd. viii, p. 8, 1891.
[3]Centrabl. f. d. med. Wiss., 1884, pp. 193–597.

PLATE XIX.



Lacerta muralis.

influence of the phloroglucine. In this solution the pieces of well fixed and washed material are placed. The decalcification is very rapid. Fœtal or young bones as well as those of the lower vertebrates are decalcified in half an hour. Older and harder bones require only a few hours. A 35% solution may be used for teeth, yet it is rarely found necessary to use stronger than 20%. If less rapid decalcification be desired the following formula may be used:

Phloroglucine.....	1 part.
Nitric acid.....	5 parts.
Alcohol, 95%.....	70 parts.
Distilled water.....	30 parts.

When decalcified the bones are washed in running water for about two days. The sections stain well and do not fade.

SCIENTIFIC NEWS.

A Grand Honorary Prize placed at the disposal of the Boston Society of Natural History by the late Dr. William J. Walker "for such investigation or discovery as may seem to deserve it, provided such investigation or discovery shall have been made known or published in the United States at least one year previous to the time of award," has been unanimously awarded to Prof. James D. Dana.

In recognition of the value of the scientific work of Prof. Dana and in testimony of the Society's high appreciation of his services to science the maximum sum of one thousand dollars has been awarded.

For the annual Walker Prizes a first prize of one hundred dollars has been awarded to Baron Gerard de Geer, of Stockholm, for an essay entitled "On Pleistocene Changes of Level in Eastern North America," and a second prize of fifty dollars to Prof. William M. Davis, of Cambridge, for an essay on "The Subglacial Origin of Certain Eskers."

The newly organized Chicago University has called bodily the whole Biological Department of Clarke University. The following persons from Clark have already accepted positions as professors, assistants, fellows, etc., at Chicago: C. O. Whitman, H. H. Donaldson, F. Mall, F. Boas, G. Baur, S. Watase, W. M. Wheeler, E. O. Jordan, C. L. Bristol, H. P. Johnson, F. R. Lillie, A. D. Mead.

The results of the great Japanese earthquake in Gifu-ken, where the damage was greatest, are thus summarized: 4889 deaths, 12,311

persons wounded, 44,203 dwelling houses completely and 21,378 partially demolished, 23,379 damaged and 4159 burned after collapse, in addition to 1744 other buildings demolished or damaged. The total number of buildings thus affected in the ken was therefore 88,011.

Recent Deaths.—Charles Smith Wilkinson, government geologist, in Sydney, N. S. W., Aug. 26, 1891, aged 46 years. August von Pelzeln, the well-known ornithologist, in Vienna, Sept. 2, 1891. P. J. F. Lowrey, lepidopterologist, at Clapham Park, England, July 24, 1891, at the age of 30 years. Dr. Max Quedenfeldt, a traveler and collector of Coleoptera, in Berlin, July 13, 1891, aged 40 years. Friedrich Wilhelm Meves, the ornithologist, in Stockholm, in April, 1891, aged 77 years. Cesare Tapparone Canefri, the conchologist, August 6, 1891, at Quattordio. Dr. Edward Killias, in Chur, Switz., Nov. 14, 1891, aged 63 years; he was a botanist and entomologist. George J. Bettany, December 2, 1891, at the age of 42. He was best known for his labors in condensing the papers of the late W. K. Parker into the useful volume "Morphology of the Skull."

Indian Literature.—The Bureau of Ethnology has just issued a collection of Omaha and Ponka letters collected and edited by James Owen Dorsey. Seventy-seven of these letters are included, each being given first in interlinear and then in translation.

Another most valuable publication for the student of American archæology, published by the same bureau, is Dr. Cyrus Thomas' "Catalogue of Prehistoric Works East of the Rocky Mountains." This is arranged first by States and then by counties, and is compiled from various sources. Like any similar first catalogue there are necessarily many omissions and mistakes, but the work will be useful, not only as a record of what is now known, but also as a means of collecting more information and correcting errors. Notes will be thankfully received by Prof. Thomas.